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***Central Eurasia:
Space***

Science & Technology

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27 August 1993

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Goals of Current Mission to Mir, Future Plans
937Q0176A Moscow KRASNAYA ZVEZDA 14 Jul 93 p 1

[Article by Mikhail Rebrov, KRASNAYA ZVEZDA correspondent, Flight Control Center: "These Are Venturesome Fellows; What's Going On Aboard the 'Mir' and What's Next"]

[Text] If you open and leaf through the ship's log in which the work of the Russian-French crew under the "Altair" project is recorded by day and by hour, you will be surprised by the great number of words which are not comprehensible to everyone: "Viminal," "Maksat," "Sinergiya," "Diurez," "Tkan," "Biostoykost," "Rekomb," "Illyuziya," "Alis"... These are the names of experiments: medical, technical, geophysical and others. Their decoding requires much newspaper space and therefore I will limit myself solely to a general explanation: continuation of study of the reaction of the human body to the extremely unusual conditions of space flight, obtaining new materials with stipulated properties, research on the Earth's natural resources, astrophysical phenomena, etc.

...The ship's log of G. Manakov and A. Poleshchuk (13th expedition) is annotated: "performed, "performed," "performed"... However, there are points which will "go over" to the 14th expedition—V. Tsibiliyev and A. Serebrov. Although they have more than enough of their own work. It also will be written down by days and by revolutions and by hours.

The five cosmonauts will stay together in the Mir up to 22 July. The return (landing) of the "Vulkan" and "Sirius-3" cosmonauts has already been determined with an accuracy to the minute: 10.35. And what then?

The fourteenth expedition continues to implement its program. V. Tsibiliyev and A. Serebrov will spend 147 days in space. Plans call for three walks into open space. Two of these will be for the deployment of a special beam construction called the "Rapan" on the body of the complex. This nine-meter structure was fabricated from a carbon plasticized material with extremely interesting properties. Under the influence of an electric current a "memory effect" will be activated in such a material and the beam will acquire the necessary "configuration."

The experiment is not only interesting in itself, but also opens up attractive possibilities. It is proposed that in the future such a construction be used in the assembly of the new Mir-2 station in orbit. But for the time being several containers with samples of different materials are being placed in the "Rapan" in order to test their resistance under the "aggressive" conditions of open space: temperature drops, exposure to meteor particles, radiation, etc.

American research instruments are mounted on the outside of the station, they must be removed, taken

into the descent module of the Progress cargo spacecraft and in that way returned to the Earth.

It is planned that the third walk take place at a later time. The objective will be to remove different structural components of the station for subsequent analysis on the Earth. The Mir is growing old, is working in orbit for the eighth year, has made more than 42 000 revolutions and therefore it is important to have a precise idea as to what space and time do to such structures.

It is proposed that the crew of "Sirius" cosmonauts also perform various kinds of repair-restoration and preventive maintenance work. It is not excluded that the "space motorcycle" (the name given to a self-contained moving vehicle) will again be put outside. Incidentally, Serebrov already had the opportunity to work with it in 1989.

If everything goes as planned, the new, fifteenth expedition will arrive at the station on 18 November. It should include the present-day standbys, Colonel V. Afanasyev and the engineer Yu. Usachev. The third crew member will be a physician-researcher, a specialist with biomedical qualifications. And whereas the first two members of the future expedition will stay in orbit for five months, which has already become the standard, the physician will return to Earth only in 1995, after having lived and worked in space 1 1/2 years. In all probability these tests will fall to the lot of V. Polyakov.

Such is the work laid out for them.

Delays in Launch of Priroda Module Discussed
*937Q0176B Moscow ROSSIYSKIYE VESTI in Russian
No 135, 16 Jul 93 n 4*

[Article by Andrey Veymarn: "Rises and Falls of 'Priroda'"]

[Text] The Remote Sensing Working Group is one of the organizations within the "Intercosmos" program. In 1981 it decided to develop a space module for studying the Earth, saturating it with modern radio-physical instruments. The interests of the scientists happily corresponded to the plans of the space technology leader, the Energiya NPO, which precisely at that time took upon itself the construction of the Mir orbital station. It was decided to outfit the complex with a radar, optical false-color camera, infrared and ultraviolet spectrometers and radiometers. Never in the history of cosmonautics had there been a station with such rich capabilities.

The scientific program included the diagnosis of the geosystem, study of the world ocean and investigation of geological processes. The launching of the module, in whose outfitting, in addition to the main and most active participants in the project, the USSR and Bulgaria, Czechoslovakia, Poland and Romania also played a role, was planned for 1992.

The project was regarded as a contribution of the participating countries to the International Space Year, which attracted to the program the scientists of France, Italy, Switzerland, the United States, Taiwan and Germany.

"Underwater rocks," inconspicuously undergoing transition into almost "insuperable cliffs," appeared in 1991, when money ran out. The year 1992 passed, but the launching still did not take place.

In rocket technology some things become outmoded fast. They deserve to be shelved, no one needs them. There are already examples of that.

I asked Professor N. Armand, scientific director of the project, deputy director of the Radio Engineering and Electronics Institute: "What are the possible negative effects of delay in the Priroda launching?"

"It is planned that the Ekos system, which will be technically far more perfect, will take place in the late 1990's. If time slips away the planned research will be carried out by others. In addition, the useful life of the Mir orbital station is far from unlimited, so that procrastination with launching is like death. Now that the program seemingly is breathing again the launch is planned for late 1994, but postponements are continuing."

"In what way may the program enrich Russia?"

"Throughout the world space survey data are being used primarily by science and planning organizations. Such experiments do not yield a direct monetary profit. Even the American Landsat program, which is regarded as commercial, is now financed by the government, but not from the goodness of the heart: science is laying the foundation for the future."

"Neither agriculture nor industry will receive a great commercial advantage from the Priroda; this is primarily a scientific program. Our principal objective is to learn how to interpret the complicated information correctly, to use it for solving geographic, ecological, meteorological and other problems, and to improve methods for evaluating natural resources. The program may become a new step on the path to creating more perfect systems for observing the Earth from space."

"It's not worthwhile to ask the question as to whether the Priroda will be launched, whether it will be the first or last link in the chain of Russian space investigations of natural resources. And one thing is evident: for the time being no one has a clear idea about what will happen."

Upcoming 18-Month Cosmonaut Mission to Mir Viewed as Mars Flight

*937Q0160A Moscow KRASNAYA ZVEZDA in Russian
31 Jul 93 p 3*

[Article by Mikhail Rebrov, KRASNAYA ZVEZDA correspondent: "Russian Cosmonauts on Mars: Will Plans Become Reality?"; the first paragraph is an introduction]

[Text] On 18 November a physician-cosmonaut will arrive aboard the Mir orbital complex and he will return to the Earth only in 1995, after passing 1.5 years in space.

Today the idea of a flight to Mars, which could be carried out through the joint efforts of Russia and the United States, has gained broad popularity. This is being talked about at their meetings by the scientists and designers of the two countries, Russian cosmonauts and American astronauts, television programs are being devoted to this and a Russian-American Martian expedition (as an idea) is at the center of attention of the press.

At the present stage in the development of space technology the project for such a journey seems no more complex than an expedition to the moon seemed in its time in comparison with man's first flight into space. It is a different matter whether man himself is capable of such a prolonged stay in space; a flight to the "Red Planet" and back will last approximately 2.5 years.

If the first step of Yuri Gagarin, 108 minutes, is compared with the impending almost 1000 days, these figures sound fantastic. But we recall what steps have already been taken, what stages have been passed through: the 23 days of work in orbit by Georgiy Dobrovolskiy, Vladislav Volkov and Viktor Patsayev; 96 days by Yuri Romanenko and Georgiy Grechko; 175 days by Vladimir Lyakhov and Valeriy Ryumin; 211 days by Anatoliy Berezovoy and Valentin Lebedev; 365 days by Vladimir Titov and Musa Manarov... To the credit of American astronauts there are 87 days of continuous flight in Skylab. In short, all the records are ours. And only today is their significance becoming evident.

Not everything is as simple as it may seem. We already learned about the "hidden springs" of the treachery of weightlessness in the course of the daylong flight of German Titov. Presence in unsupported space causes a sensation of the body being upside down and dizziness, there seems to be a spatial displacement of objects, there is nausea, impaired coordination and a loss of appetite... All this symptom complex came to be known as "space motion sickness." Its symptoms are manifested particularly clearly during the first five-seven days of flight and they reduce cosmonaut efficiency, preventing the performance of individual tasks, and with the appearance of extremal situations may

threaten the life of crew members. During prolonged flights the muscles of a cosmonaut lose mass and the bone tissue also is subjected to changes associated with loss of calcium salts. Is all this dangerous?

"For the time being, no," says Academician Oleg Gazenko. "The scope of our knowledge at the present time makes it possible to ensure man's flight in space at an acceptable risk level." And in this assertion of the scientist there is no feigned optimism. The accumulated experience in medical support of prolonged orbital flights makes it possible to maintain a high crew performance during an entire flight. Moreover, with respect to a whole series of parameters the degree of change was less clearly expressed than during shorter flights.

Such are the facts. Analyzing the results of multiyear research and experiments as a whole, one gets the impression that man can satisfactorily adapt to prolonged exposure to weightlessness, and upon completion of prolonged flights can readapt to terrestrial gravity.

But we will return to the impending flight of the physician-cosmonaut. Readers reacted in different ways to the communication concerning this. Some deemed this information to be clamorous-sensationalist; others sullenly commented: why, they say, is all this necessary; still others did not conceal their pride: "We, no one else, were the first to begin the laborious storming of space. As is well known, the most complex trials fall to the lot of discoverers and pioneers. We will not retreat..." Personally I share the point of view of the third group because without space research there can be no progress on the Earth.

And nevertheless, when you visualize the 1.5-year journey in the Mir, in time and space, as they say, it takes your breath away. This is almost 15 000 revolutions around the planet, 600 million "space kilometers," a relatively monotonous diet, a quite cramped closed volume of the "space home," periodically repeating pictures of the Earth and star sky... Not everyone has the strength for this: either with respect to physical tests, or psychologically. Who, however, will become this pioneer?

In all likelihood, Valeriy Polyakov. What credentials does he have for this flight? First of all, he is a highly trained physician, to be more precise, a specialist in biomedical research. Secondly, experience: in his service record there are 240 days 22 hours and 35 minutes of work in space. Thirdly, he has been extremely carefully trained for this journey and is continuing his training now. There is no concern about his courage or his will... And so on and so forth. However, I will not dot all the i's and cross all the t's; there are still more than a hundred days prior to the launching.

Are we not losing our sense of reality, are we not going too far in the play of imagination when we draw up plans for a Martian expedition? No, there are entirely specific variants. One of the projects involves use of the Energiya booster to launch into orbit an enormous platform from which a rocket would be launched to Mars. Another variant is to assemble a rocket directly in orbit. But this, naturally, requires that a series of preparatory measures be taken: launching of a small Martian "moon" and research probes and then dropping onto Mars robots which would drill the Martian ground and return to the probe-carrier with soil samples which then would be delivered to the Earth. And then will come a line of people.

In short, there are no insoluble problems in sight. Taking into account, however, that reference is to man, his health and safety, each new step into space must be scrupulously weighed, must be supported by the most careful and detailed study and newly obtained results, and all preceding experience. Nothing must be lost from view, including the remote aftereffects of space-flights.

How much will all this cost? This is not an idle question. Large-scale projects in the name of science and progress require billions. Carl Sagan, a professor at Cornell University in the United States, is convinced that manned flight to Mars would be far cheaper than Star Wars, cheaper than the American Apollo program and much cheaper than the development of any major strategic arms system.

But, I repeat, all this is possible only on the basis of broad cooperation of peoples in the mastery of space: both a manned expedition to Mars and even a solution of more complex problems in the mastery and transformation of the solar system. I foresee objections and even indignation among some readers: lower your eyes to the sinful Earth, take a look around: the country is almost in collapse, warfare is flaring up along the borders, refugees are moving in torrents... And he's talking about Mars!

How to answer this? We have to rise above the ruins. The wars must be brought to an end. And the refugees must be settled down. But this alone is too little for the country to occupy a fitting place in the world hierarchy of states, for life in it to become truly humane. Come what may, it is necessary to look to the future, dream of the stars and make what has been attained in space accessible for the well-being of all of us, present and future! Even the grotesque medieval gargoyles were unable to conjure up this dream. Is it possible that today we are in no position to rise to the challenge—with our national pride, peace, the universe?!

As you wish, but I believe that apple trees will blossom on Mars. Ours, Russian!

Manned Mission Highlights

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Historical Steps in the Martian Legend

1962—The Mars-1 station set off on its interplanetary trajectory.

1971—The Mars-3 landed on the "Red Planet."

1986—The first permanently manned Mir space station.

1988—V. Titov and M. Manarov made a space flight lasting 365 days 22 hours and 39 minutes.

1994-1996—Two of our stations will depart for Mars and will deliver improved landing modules and self-propelled vehicles to the planetary surface.

2007—First possibility for a manned expedition. At that time the Earth and Mars will be separated by the shortest possible distance, which does not occur often.

Optimum Spatial Entry of Space Vehicle Into Geostationary Orbit From Artificial Earth Satellite Orbit

937Q0165A Moscow *IZVESTIYA AKADEMII NAUK: TEKHNICHESKAYA KIBERNETIKA* in Russian No 3, May-Jun 93 (manuscript received 4 Jul 92) pp 116-126

[Article by K. G. Grigoryev and A. V. Fedyna, Moscow State University, Moscow; UDC 629.13]

[Abstract] A solution is given for the problem of optimum spatial entry into a geostationary orbit of a spacecraft with a high-thrust engine from a low circular orbit of an artificial earth satellite of arbitrary inclination. Entry control is by use of the thrust vector. The Earth's gravity field is assumed to be a central Newtonian field. Entry is examined as a transfer from orbit to orbit: the launching point and finish are not stipulated and are obtained as a result of solution of the problem. A functional representing a stipulated compromise between the expenditures on injection of mass and time is minimized. This makes it possible to examine the optimum entry trajectories with a minimum expenditure of mass during a limited time, including the trajectory for entry into the first orbit. The problem is solved on the basis of the maximum principle and the corresponding boundary value problem is solved by the shooting method. The computations of the optimum entry trajectories are made in a broad range of change in the parameters of the problem: altitude and inclination of the launching orbit, initial thrust-to-weight ratio of the spacecraft, specific thrust and ratio of the compromise coefficients. The results of the computations are given in four figures and two tables. Figures 5; references: 33 Russian.

The Lunar Hydrogen Problem

937Q0164A Moscow *ASTRONOMICHESKIY VESTNIK* in Russian Vol 27 No 3, May-Jun 93 (manuscript received 4 Feb 93) pp 30-39

[Article by V. V. Shevchenko, G. A. Leykin and A. N. Sanovich, State Astronomical Institute imeni P. K. Shternberg; UDC 523.83]

[Abstract] There are two important problems related to the existence of lunar hydrogen and water: 1) what are the possible sources of water and hydrogen?; 2) if water existed on the moon, could it have been conserved there during the long period of lunar evolution? The literature on the subject is critically reviewed and original hypotheses are examined. There are two fundamentally different types of sources: endogenous and exogenous. The principal endogenous source is the release of volatiles in the course of volcanic eruptions. Condensates of volatiles also may be conserved on the fragments of walls of lava tubes if in the process of surface evolution they remained buried at a depth of about 1 m or more. There are four types of exogenous sources, such as the falling of meteorites and micrometeorites (as well as comets and asteroids) on the moon. Other sources include the incidence of individual atoms or ions on the moon, as in the solar wind and in streams of galactic cosmic rays. The total supplies of hydrogen on the moon are in the form of hydrogen present in the fine fraction of lunar ground, about 10^{16} g. A hydrogen quantity comparable in magnitude may be present in polar cold traps and in lava tubes. Polar traps and lava tubes, in contrast to oxygen in the ground, may be sources not requiring reworking of a considerable quantity of the "ore." The subject is important relative to the possibility of establishing a manned lunar base. Figure 1; references 32: 6 Russian, 26 Western.

Martian Gravity Field

*937Q0153A Moscow ASTRONOMICHESKIY VESTNIK
in Russian Vol 27 No 2, Mar-Apr 93 (manuscript received
21 Dec 92) pp 12-22*

[Article by Ye. M. Koshlyakov and V. N. Zharkov,
Earth Physics Institute imeni O. Yu. Shmidt, Russian
Academy of Sciences; UDC 523.42:551]

[Abstract] Maps of the heights N of the areoid and gravity anomalies δg were plotted using data on the Martian gravity field (gravitational potential was expanded to the 50th degree and order). Reckoning was from the hydrostatically equilibrium figure of the planet. The map of areoid heights is divided into two diametrically opposite positive anomalies in the equatorial zone, the western of which is associated with the Tharsis plateau. The smaller-scale anomalies are suppressed by the long-wave component and after elimination of the first four harmonics from the expansion of potential areoid anomalies were used for their detection. The anomalies associated with a number of impact and volcanic structures can be seen after removal of the long-wave background. Both large- and small-scale details of the Martian gravity field are manifested most clearly on the map of gravity anomalies δg . Among the interesting features are the gigantic mascon structures of Utopia, Isida and possibly Hellas. The appreciably greater negative anomalies in the north polar zone than in the south polar zone are associated with the well-known topographic dichotomy of Mars. An annular negative anomaly was discovered around the sheet volcano Olympus. The interpretation of the positive anomaly directly over Olympus is reexamined, which makes it possible to estimate the effective density of the volcanic structure at 1.2 g/cm^3 . It is postulated that Olympus has a broad crustal "root" at the crust-mantle boundary which can be regarded as a floating basement supporting this structure and which causes a negative gravity anomaly at the periphery of the volcano. Mars Observer data evidently were unavailable when this article was prepared. Figures 4; references 12: 4 Russian, 8 Western.

Mineralogical and Velocity Section of Martian Crust

*937Q0153B Moscow ASTRONOMICHESKIY VESTNIK
in Russian Vol 27 No 2, Mar-Apr 93 (manuscript received
21 Dec 92) pp 55-75*

[Article by A. Yu. Babeyko, S. V. Sobolev and V. N. Zharkov, Earth Physics Institute imeni O. Yu. Shmidt, Russian Academy of Sciences; UDC 523.42:551]

[Abstract] The numerical thermodynamic simulation method was used in constructing mineralogical sections of the Martian crust. The mineralogical composition of the crust varies with depth due to a transition of the gabbro-eclogite type. The density sections and the velocities of longitudinal and transverse waves

were computed from the mineralogical compositions. The computations were made for three compositions of Martian basalts and for three variants of crustal temperature: with gradients 21, 13 and 6 K/km. Martian isotherms were plotted by solution of the stationary thermal conductivity problem with transfer of some of the radioactive sources into the crust. The heat flow at the surface ($30-45 \text{ erg/cm}^2 \times \text{s}$), crustal thermal conductivity ($2-3 \text{ erg/cm} \times \text{K}$) and the fraction of sources transferred into the crust (0.25-0.75) were varied. The lower part of the thick crust is probably in a state of subsolidus convection. Two crustal levels can be defined. The upper crust ($z < 50 \text{ km}$) is made up of ferruginous gabbroids and is characterized by a constant density or densities and velocities of elastic waves slightly decreasing with depth. For the two most realistic compositions the mean densities, V_p and V_s of the upper crust are slightly dependent on the temperature distribution. The structure of the lower crust ($z > 50 \text{ km}$) is different for different compositions and in addition is substantially dependent on the temperature distribution. The simplest structure with a sharp increase in density and velocities of elastic waves is characteristic for "cold" crusts. With an increase in crustal temperatures the mineralogical composition of the rocks changes, zones of reduced velocities and densities appear and the mean values of the parameters decrease. The results may be useful in interpreting seismological and electromagnetic sounding data and in constructing a rheological model of the Martian crust and models of regional Martian tectonics. Figures 10; references 16: 6 Russian, 10 Western.

Methods for Identifying Martian Rocks Using Data From Instrument Package Carried Aboard 'Mars-94' and 'Mars-96' Spacecraft

*937Q0153C Moscow ASTRONOMICHESKIY VESTNIK
in Russian Vol 27 No 2, Mar-Apr 93 (manuscript received
24 Jul 92) pp 76-84*

[Article by S. S. Arutyunyan, S. Yu. Surkov and Ye. Ye. Shlafshteyn, Geochemistry and Analytic Chemistry Institute imeni V. I. Vernadskiy, Russian Academy of Sciences; UDC 523.43-36]

[Abstract] The possibility of identifying rocks on the Martian surface using penetrators is examined. A series of experiments which it is proposed be carried out with penetrators for determining the chemical composition and physical properties of the rocks is outlined. The selected set of measurable rock characteristics is validated by research on terrestrial magmatic rocks of different compositions and ages. The principles of the method for separating and identifying magmatic rocks without the taking of samples by the processing of the results of measurements made on the basis of use of variants of factor analysis are set forth. The information yield of a number of petrophysical and petrochemical characteristics of the rocks and the probabilities of separation of families of magmatic rocks on the basis of individual characteristics and

their combinations are examined. The admissible errors in measuring individual characteristics are ascertained. The results of tests in Northern Kazakhstan of part of the instrument package intended for mounting on penetrators are briefly described. The tests of this equipment indicated the possibility of ensuring the required accuracy in determining the rock characteristics, their petrochemical and petrophysical

parameters. A table lists the experiments which it is proposed be carried out within the framework of the "Mars" program using orbital modules, penetrators, small stations, balloons or Martian rovers; the experiments and methods, type of data to be collected in each case and instrument carrier are identified. However, only those experiments which would yield information on rocks are discussed. Figure 1; references: 6 Russian.

Determining Dynamic Characteristics of Elastic Moduli of Spacecraft Using Data From Frequency Tests of Their Elements

937Q0154A Moscow KOSMICHESKIYE
ISSLEDOVANIYA in Russian Vol 31 No 3, May-Jun 93
 (manuscript received 4 Jan 92) pp 16-24

[Article by V. R. Aminov and V. P. Korotkov; UDC 629.7]

[Abstract] The possibilities for determining the dynamic characteristics of a complex structure are analyzed on the basis of the results of frequency tests of its individual elements. The method is illustrated in the example of transverse oscillations of a homogeneous elastic rod with one end fixed and the other end free. The rod consists of two elements of different lengths. The movements of the elements are represented in the form of expansions of the characteristic forms of oscillations of the first element with attachment to its free end of an ideally rigid body having mass-inertial characteristics similar to the characteristics of the second element and the characteristic forms of oscillations of the cantilever-attached second element. The effectiveness of this approach is demonstrated in the examples of oscillations of such a two-element rod and spacecraft standard solar cell panels. The consistency between the computed and experimental values is satisfactory for the first two tones of the oscillations. Damping, not dependent on the frequency of oscillations, in general agrees better than in a viscous case. For the higher tones of oscillations the computed values of the decrements considerably exceed the experimental values. This is attributable to the experimentally detected correlation between anti-symmetric and symmetric forms of oscillations. Figures 8; references 20: 17 Russian, 3 Western.

Analysis of Optimality of Two-Impulse Rendezvous Trajectories for Two Vehicles in Circular Orbit

937Q0154B Moscow KOSMICHESKIYE
ISSLEDOVANIYA in Russian Vol 31 No 3, May-Jun 93
 (manuscript received 30 Mar 92) pp 43-56

[Article by V. V. Ivashkin and G. G. Raykunov; UDC 629.197.2]

[Abstract] The problem of analysis of optimality of two-impulse maneuvers for a "soft" rendezvous of two spacecraft initially moving in the same circular orbit is examined. The problem is formulated as follows. There are two spacecraft moving in the same circular orbit in the central Newtonian field of a planet characterized by a given gravitational constant. The initial angular distance between these spacecraft is known. The angle is reckoned in the direction of motion from the first spacecraft to the second. At the initial moment

in time a command is sent for the first (maneuvering) vehicle to execute an orbital rendezvous maneuver at a given time with the second (passive) vehicle. By the "rendezvous of two spacecraft at some moment in time" is meant a "soft" rendezvous, that is, the coincidence at that moment in time of both their coordinates and velocity components. It is required that the total time for executing the rendezvous maneuver not exceed some limiting time. Limitations also are imposed on the distance from the spacecraft to the center of gravity. The Lawden primary vector method was used in an analysis of the optimality of the initial two-impulse solutions. Qualitative and quantitative analyses of the characteristics of solution of the rendezvous problem with a change in the angular mismatch between the vehicles and the limiting transfer time were made. The ranges of optimality of two- and multi-impulse solutions were determined. A numerical analysis was made, for the most part for the case of the initial motion of the spacecraft in a geostationary orbit. Figures 8; references 20: 17 Russian, 3 Western.

Algorithm for Nonautonomous Terminal Control of Space Glider With Guidance to Radio Beacon

937Q0154C Moscow KOSMICHESKIYE
ISSLEDOVANIYA in Russian Vol 31 No 3, May-Jun 93
 (manuscript received 29 May 91) pp 64-73

[Article by L. V. Morozov and V. M. Belokonov; UDC 531.381]

[Abstract] The atmospheric descent of a small space glider with a high aerodynamic quality with an automatic control system and a parachute landing method from an earth satellite orbit is examined. The control problem involves guidance of the space glider to a point in space above a landing point with stipulated coordinates when there are random disturbances in the descent process. In order to increase guidance accuracy an algorithm is proposed for synthesis of a multistep adaptive nonautonomous terminal control in the segment of near guidance of the vehicle to an omnidirectional radio beacon. The algorithm is fully described and application of the method is illustrated, including by a diagram of descent in the near guidance segment (which is fully interpreted in the text). The simulation results make it possible to conclude that the proposed nonautonomous terminal control of such a vehicle in the near-guidance segment, based on multistep correction with the use of glidepath trajectories, is effective. The proposed method for the synthesis of two-channel control of the banking angle and aerodynamic quality is effective both for the considered piecewise linear program for the banking angle with two modulating functions and for a step program for the banking angle with one modulating function, for which the methodological guidance accuracy is about 0.06 km. Figures 3; references: 5 Russian.

Constructing Trajectories of Geocentric Propulsion of Spacecraft With Solar Sail

937Q0154D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 3, May-Jun 93 (manuscript received 20 Jan 92) pp 74-90

[Article by V. V. Smirnov, V. A. Yegorov and V. V. Sazonov; UDC 629.015]

[Abstract] The trajectories for the propulsion of a spacecraft with a solar sail from low geocentric orbits to emergence from the sphere of the Earth's influence are constructed. Propulsion variants, including a perturbation maneuver near the moon, were investigated. The sail is plane with a two-sided specular surface. A locally optimum law, at each moment in time ensuring a maximum rate of increment of the total geocentric energy of the spacecraft, was adopted as the fundamental law for sail control. A passive flight segment is introduced for executing a perturbation maneuver in which the sail surface is set parallel to the sun's rays. The required conditions for a close lunar flyby are ensured by careful choice of the moments of time of beginning and end of the passive segment. A perturbation maneuver makes possible a considerable reduction in spacecraft flight time to the boundary of the Earth's sphere of influence in comparison with the case of use of a locally optimum control law without spacecraft convergence with the moon. For starting orbits with a small inclination to the lunar orbital plane a method is proposed for executing a perturbation maneuver, including reduction of the spacecraft orbit to the lunar orbital plane. The effect of a decrease in the perigee of the osculating orbit of the spacecraft in the process of geocentric propulsion, arising in some cases, is investigated. A sail control law making it possible to avoid this effect is proposed. Figures 7; references 10: 9 Russian, 1 Western.

Use of Indirect Data for Monitoring Periods of Electrification Disturbances of High-Orbit Satellites

937Q0154E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 3, May-Jun 93 (manuscript received 16 Jul 90) pp 128-137

[Article by G. V. Popov and O. S. Grafodatskiy; UDC 550.388:537.221]

[Abstract] Spacecraft electrification results from interaction with the ambient medium and high-orbit spacecraft may be charged to high negative potentials. Geostationary satellites may be charged to tens of kV, possibly resulting in microelectronic systems malfunction and breakdown. On the basis of experimental data on the electrification of Gorizont communication satellites simple necessary and adequate conditions are defined under which electrification disturbances arise and provoke malfunctions and maladjustments in the operation of spacecraft instruments. This made it possible to propose a method making it possible for a specific spacecraft to judge satisfaction or nonsatisfaction of

these conditions on the basis, on the one hand, of empirical information on the geometry and dynamics of large-scale magnetospheric-ionospheric structures and, on the other hand, of the results of current standard geophysical observations made by the network of surface stations. An example of use of this method is given. Even in its simplest variant there is even now evidence of the good possibilities for such an approach and of the reality of practical implementation of monitoring of disturbances of electrification of high-orbit spacecraft. Ways to improve monitoring, increasing its reliability and spatial-temporal resolution, are suggested and the good prospects for transition from monitoring to prediction, evident from the basic monitoring principles outlined in the article, are discussed. Figures 3; references 24: 16 Russian, 8 Western.

Early Work on Tether Systems for Spacecraft Artificial Gravity

937Q0154A Moscow KRASNAYA ZVEZDA in Russian 8 Jun 93 p 2

[Article by Mikhail Rebrov, KRASNAYA ZVEZDA correspondent; "IT" Project; the first paragraph is an introduction]

[Text] An American-Italian experiment with a tethered satellite was carried out in late July-early August of last year on a scheduled Shuttle flight. As reported in the foreign press, the scientists of the two countries planned a broad program for studying microgravitation and potential sources for producing electric power in space. NASA specialists hastened to include the experiment among national priorities. And although the intended plan was not implemented due to technical malfunctions, this experiment has a curious prehistory, but with Russian, not American roots.

The ideas of K. E. Tsiolkovskiy were given that attention by Korolev which was characteristic of a person having a capacity for looking far into the future. The thought of Konstantin Eduardovich of constructing a spaceship with artificial gravity seemed to Korolev to be entirely sound and the chief designer quite frequently returned to it at technical conferences. He did not set specific times, did not hurry, but only attentively heard his opponents out. "We will fly a long time, you wait and see!"—such were his words. Late in 1964 Korolev proposed to Boris Viktorovich Raushenbakh, a specialist at OKB-1 [Special Design Bureau-1], that he undertake further development work on the problem. Thus began the story of the "IT" (artificial gravity) project. Stamped "Top Secret."

The conceptual part seemed quite clear-cut. The system was visualized in the form of a "space carrousel." The Voskhod ship and the last stage of a booster were connected by a tether and untwisted about a common center of mass. An acceleration should arise due to the centrifugal force aboard the ship.

"The experiment itself," recalls Professor V. Syromyatnikov, "contained no secret and consisted of the

following stages: a spaceship (mass 6400 kg) is separated from a rocket stage (mass 30 000 kg) and the two objects diverge by 5-10 m. Then a solid-fuel rocket engine is fired and the stage "withdraws" from the ship. The tether is freely unwound from the winch drum. Its length exceeds a thousand meters...

Thus, the objects diverged, the tether was made taut, "lateral" slides were activated, which also created rotation. The magnitude of the artificial acceleration was selected on the basis of lunar gravity, one-sixth of that on the Earth. In those years work was being done actively on preparations for a manned lunar expedition. The angular velocity of system rotation was 1.5 degree per second.

Then the objects had to be drawn together. It was proposed that the distance between the objects be reduced to 300 m and that the angular velocity be increased to 12 degrees per second. The experiment was completed with the shooting away of the tether from the rocket stage.

A technical conference was held in the autumn of 1965 at which a report was given on the readiness to begin flight tests. It was planned that they take place on two *Voskhod* spaceships. It was intended that the first be put into orbit in the spring of 1966. A team of cosmonauts which included Yuriy Gagarin headed off for prelaunching training at *Zvezdnyy*.

A ship with the artificial gravity system was manned and sent off to Baykonur. But in January 1966 Korolev died and all work on the artificial gravity project ended.

"The system only outwardly seems simple," says the chief designer Syromyatnikov. "Then, more than a quarter-century ago, this project advanced cosmonautics to still another important limit which had not been previously attained. And this was not just the matter of artificial gravity, the creation of accelerations of a variable intensity and checking their effect on the human body. The idea of tether systems is extremely promising for the assembly of large prefabricated structures in space, be they solar electric power stations, antennas of radiotelescopes, beams for the placement of different instruments, sail and reflection structures, etc."

There was still another important intention in this project. In the current-conducting tether, an electric current should be induced due to interaction with the Earth's geomagnetic field.

For those years this was a complex engineering problem. It was necessary to measure longitudinal oscillations of the tether and the angular oscillations of the object, to extinguish them, to stabilize the "linkup" and check the tension on the tether in each stage in the unwinding. And only one step separated us from what had been intended. But... And this again is a "but," which like nothing better characterizes our period of stagnation. But the fact is that our *Mir* complex and *Progress* transport ships are affording unique opportunities for continuing the experiments. And here there are new interesting variants, such as positioning the tether vertically. A stable system is obtained: after the

attenuation of oscillations it begins to rotate with a velocity equal to the orbital velocity and is gravitationally stabilized. In such a design a number of unique phenomena arise which are related to mechanics, interaction with the magnetic field and variations in tensile stresses. It is not without reason that the Americans are duplicating what we began almost three decades ago.

'Okean' Space Launch System Designed for Offshore Launches

937Q0071A Moscow *KOMMERSANT DAILY* in Russian
16 Jan 93 p 2

[Article by Mikhail Sergeyev: "'Kosmoslot' Intends to Sell System for Launching Satellites From Sea Platforms"; the first two paragraphs are an introduction]

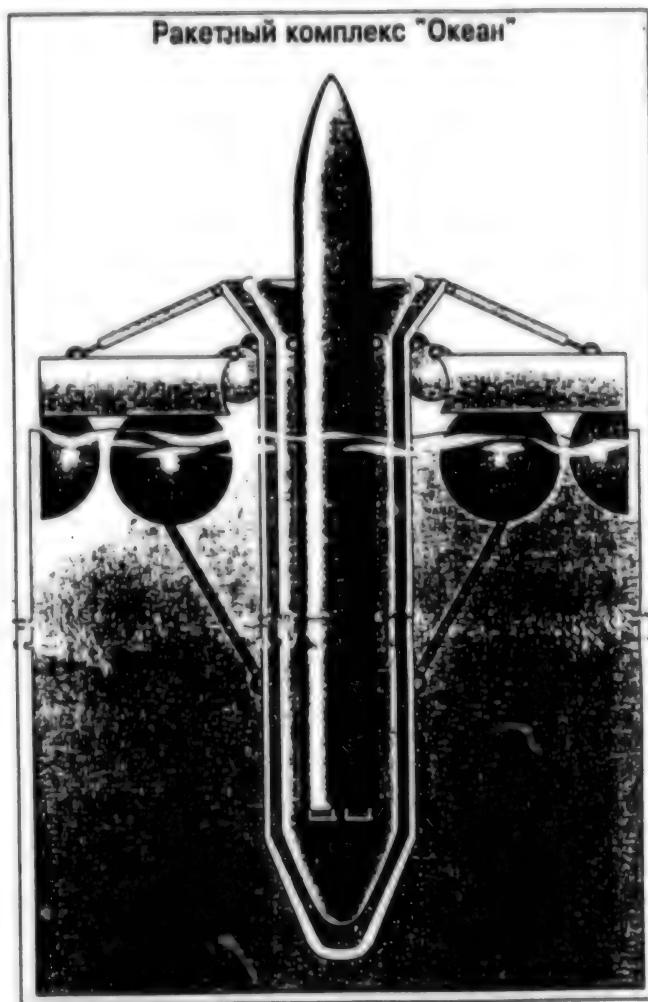
[Text] Russian rocket enterprises are persistently striving to break into the world market for commercial launching apparatus. The next such attempt is now being undertaken by the Kosmoslot Scientific-Technical Center, which yesterday proceeded to the stage of detailed designing of "Okean" floating cosmодromes and modernized military boosters for the launching of satellites into low circumterrestrial orbits.

The Kosmoslot Scientific-Technical Center specializes in projects for commercial use of high technologies. The constituents are several tens of joint-stock companies, joint enterprises, as well as state organizations, among them the Energiya and Molniya Scientific Production Associations and the Salyut Design Bureau.

The planned "Okean" system for satellite launchings at sea is a confining shaft with a modernized ballistic missile positioned on a towed sea platform. Such an unusual technical solution, in the opinion of the designers, eliminates problems associated with the alienation of great land areas and construction of a national cosmodrome. In addition, with launching from neutral waters the COCOM restrictions, forbidding the launching of Western satellites from CIS cosmodromes, do not apply and, finally, the possibility appears for the launching of satellites into equatorial orbits with lesser expenditures.

Kosmoslot specialists assert that the "Okean" system will be commercially effective even with a cost of delivery of a payload into a low circumterrestrial orbit of about 4000 dollars per kilogram, which is at least five times less than the rates presently prevailing in the world market. The decrease in costs will be favored by the use of military rocket assemblies in standard production in Russia. The "Okean" system will be capable of launching about 2 tons of payload into a low circumterrestrial orbit at an altitude 300 km. The designers estimate the expenditures on constructing the "Okean" complex and in implementing the first 65 commercial launchings to be approximately 200 million dollars. The net profit to investors in this case will be from 30 to 50 million dollars.

Kosmoslot telephone: (095) 939-12-21



Processing of 'Okean' Spacecraft Data for Classification of Vegetation of Boreal Forests
937Q0148A Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 93 (manuscript received 28 Dec 92) pp 25-34

[Article by G. I. Belchanskiy, I. N. Mordvintsev, G. K. Ovchinnikov, V. G. Petrosyan, D. Douglas and L. Pank, Institute of Evolutionary Morphology and Ecology of Animals imeni A. N. Severtsov, Russian Academy of Sciences, Moscow; Alaska Fish and Wildlife Research Center, US Fish and Wildlife Service, Anchorage; UDC 528.854:535.36]

[Abstract] Earlier articles by the authors dealt with the preparation of software for the many-sided processing of low-resolution radar data and synchronous surface observations relative to the monitoring of boreal forests using forest resources geoinformation systems. The article gives the results of further research on these matters with emphasis on the various aspects of processing of data for the optical range from spacecraft of the Okean series (MUS-M, RM-08) for classification of vegetation in boreal forests. A block diagram clarifies the steps in collection, storage and processing of data, including the following systems: planning of an experiment for selecting the optimum aerovisual and surface observations synchronous with spacecraft observations; collection of information for checking data from different observation sources and support for input into a database; data storage for systematizing aerospace, surface and service data; data processing for preliminary and thematic processing of aerospace and surface data; geoinformation system for data processing; plotting of thematic maps and preparation of information documents. Other block diagrams show details of the data storage system, data processing system and thematic data processing system. A data processing flowchart also is included. These five block diagrams serve as a basis for the text. An automated classification technology is proposed, as well as a data processing logic, a combination of initial and synthesized channels. Figures 6; references 12: 6 Russian, 6 Western.

Evaluations of Accuracy in Monitoring Orbit of Satellite of 'Meteor- 3' Series Using System for Predicting Motion of Artificial Earth Satellites of International 'Radiation Balance' Project

937Q0148B Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 93 (manuscript received 9 Apr 92) pp 40-47

[Article by A. P. Trishchenko and N. V. Yemelyanov, Scientific Research Institute of Hydrometeorological Information-World Data Center, Obninsk; UDC 551.501.721]

[Abstract] A system for predicting the motion of meteorological satellites created for the "Radiation Balance" project and methods for using it in the on-line

processing of satellite meteorological information of different types is examined. An analytic model of motion, constructed on the basis of a model of an intermediate orbit in the generalized problem of two fixed centers, is used in this prediction. A method for more precise determination of the orbital elements and the empirical coefficient of angular acceleration was developed and applied for increasing the accuracy in predicting the motion of a satellite on the basis of data from earlier orbital measurements. The use of earlier data makes it possible to increase the accuracy in predicting satellite motion by a factor 1.5-2 for the "Meteor-3" satellites. For a 28-day interval the mean prediction accuracy over a 25-month period was about 17 km for the "Meteor-3/3" satellite. For a 14-day interval the mean prediction accuracy over a 5-month period was about 11 km. The best prediction accuracy is ensured when using measurements of orbital parameters over an interval 1-2 months for refining the initial orbital elements. In order to increase the accuracy in precomputing satellite position it is necessary to increase the frequency of measurements of orbital parameters; orbital measurements once a week should make it possible to ensure a prediction accuracy within the limits +/- 5 km. Figure 1; references 6: 5 Russian, 1 Western.

Determining Spatial Resolution of Multiband Scanning Devices From Results of Control Surveys

937Q0148C Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 93 (manuscript received 16 Apr 92) pp 57-62

[Article by V. V. Gogokhiya, Scientific Geoinformation Center, Russian Academy of Sciences, Moscow; UDC 621.379.13:629.783]

[Abstract] A method is given for evaluating the spatial resolution of survey systems operating in the optical range on the basis of an analysis of the images of test subjects by the Fourier transform method. An analytic model of changes in the spatial resolution of television survey systems as a function of illumination, atmospheric state and the reflective characteristics of subjects in a survey region is proposed. In contrast to traditional approaches, the term "resolution" is understood as the period of a special mire. As the parameter determining the spatial resolution of a survey system it is legitimate to use the minimum period of a reliably distinguishable mire on a registered image. In order to determine such a mire it is necessary to stipulate the brightness of the constant component, the amplitude of the variable component and the period of the mire. Insofar as is known, such mires have never been used for calibrating survey systems used in studying natural resources and the world ocean. Specially selected control subjects are used in this connection. Such a subject can be represented as a superposition of harmonic mires with a different period and different direction of a two-dimensional wave vector. The amplitude of such

a plane wave is determined by the type of subject and is computed relatively simply from the image using a two-dimensional Fourier transform. The circumstances which must be taken into account when determining spatial resolution evaluated by such a method are examined. The results of evaluations of the spatial resolution of the MSU-M (Okean-O No 2) low-resolution scanner by the proposed method are given and a table gives the results of spatial resolution of some types of survey systems evaluated by the described method. Figure 1; references: 9 Russian.

Status of Russia's Environmental Satellite Programs

937Q0142 Moscow NEZAVISIMAYA GAZETA
in Russian 10 Jun 93 p 6

[Article by Anatoliy Zak, under the rubric "Details": "Satellites for the National Economy of Russia: The Today and Tomorrow of Space-Based Monitoring"]

[Text] The Russian Space Agency (RSA) seems to have made it a tradition to acquaint journalists with the future space program. Recently, it presented the plans for our space department in the fields of meteorology, ecology, and remote sensing of the Earth.

Russia has inherited from the Soviet Union a unique space complex that enables extensive research on the Earth's natural resources and on hydrometeorology. The complex includes series-produced satellites of five types, two ground-based tracking stations in Novosibirsk and Khabarovsk, and the Priroda data-processing center in Moscow. The only others in the world to have such technical capabilities are the United States and Western European countries. Today, however, the Russian satellites and ground stations must be re-outfitted with data-transmission systems that operate on standard international frequencies. Only then will it become possible for Russian satellites to service foreign consumers quickly. And conversely, the ground stations will be able to receive directly the data of Western space vehicles. It wasn't until December 1992 that Russia became a part of the international committee that standardizes relations in that area.

Another headache for RSA is the absence of advanced systems for processing satellite-derived information, systems that, traditionally in the former USSR, developed considerably more slowly than did the space vehicles themselves. Ultimately, as with Western countries, Russia is faced with the problem of "educating the consumer," that is, with creating conditions in which potential users of satellite information—from the farmer to the ministry—are solidly convinced of the need for such information.

In order to expand the capabilities for remote sensing of the Earth even more, RSA intends to enlist in that work heretofore secret satellites that are engaged in reconnaissance for the Ministry of Defense. In the words of Yuriy Milov, deputy director of RSA, newly designed reconnaissance satellites will be invested with

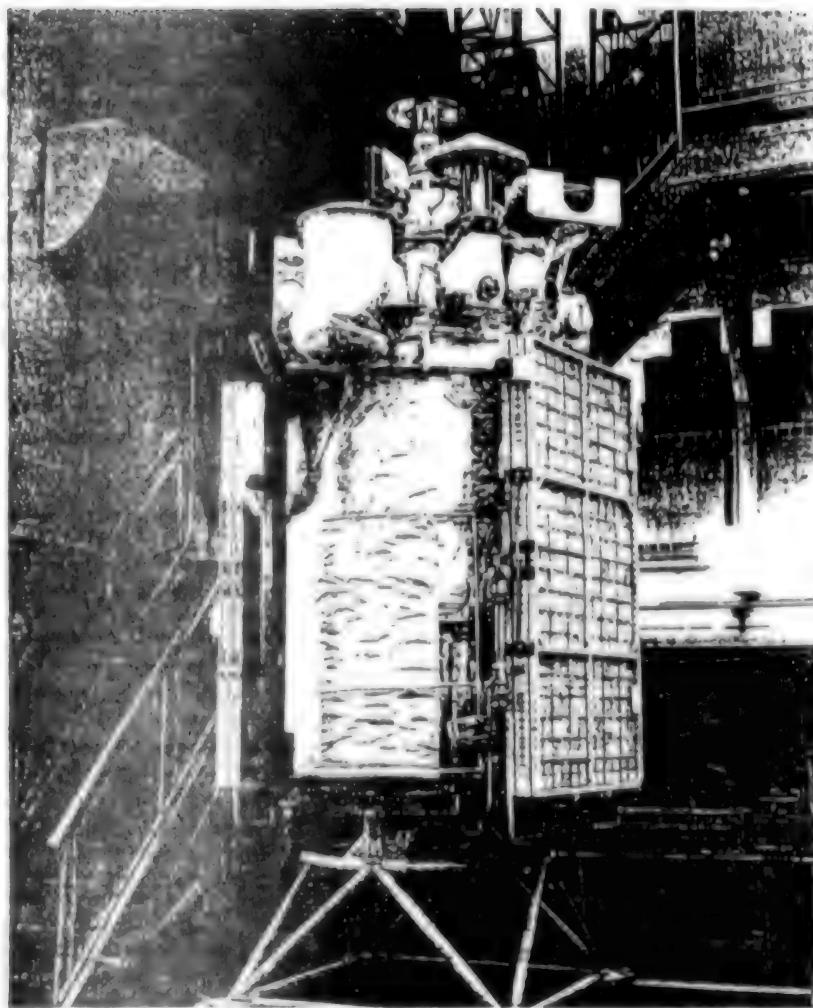
capabilities that enable the information they derive to be used for commercial purposes. At the same time, Milov noted that the specifics of the operation of the space-based spies certainly don't always correspond to the needs of civilian consumers.

It is for that very reason that RSA hopes to maintain and improve its own fleet of national-economy satellites. In the summer of this year, Russia will, for the first time, launch a weather satellite (an Elektro-type satellite) into stationary orbit. (The launch date may be pushed back as a result of the 27 May accident with the Proton launcher.) The Electro vehicle will hover over the equator at 78° E long and will be part of an international network that includes American, European, and Japanese satellites. Up to now, Russia has had only low-orbit Meteor-type weather satellites that circle the Earth synchronously with the Sun. The Meteor system will also be kept in working order; specifically, in August of this year, a Tsiklon launch vehicle will lift the next regularly scheduled satellite of that type into orbit. Its payload will include an instrument manufactured in France.

Russia is using the Resurs F satellites, which are placed into a polar orbit of 250-300 km altitude, to perform detailed photography of the Earth for geologic and cartographic purposes. Those vehicles are the "grandchildren" of the first Soviet manned Vostok vehicle and, at the same time, the brothers of today's reconnaissance satellites. What they have in common is the presence of a return vehicle that delivers film of regions that have been photographed. Two Resurs F-1 satellites are to be launched this year (in June and August), and a Resurs F-2 vehicle, which differs primarily in the specifications of its photography gear, is to be put into orbit as early as May.

According to the current RSA plans, Resurs vehicles will replace each other in orbit all the way to 1997. Plans call for in-orbit checkout to get under way in 1996 for the Kuban space vehicle, which ultimately is to replace the Resurs vehicles. The new satellite will, like those before it, return film in return capsules, but it is to carry a large stock of fuel and film and will have an improved orientation system. The Kuban will operate in orbit for 45 days, which is roughly twice as long as the service life of the Resurs F vehicles.

Nevertheless, regardless of what modifications are made, the need to wait each time for the landing of a film capsule remains a congenital shortcoming of such satellites. For that reason, the West some time ago completely abandoned that method of sending back photographs and turned to systems that relay coded images by radio link. That's how the French SPOT satellite works, as well as the American Landsat and Keyhole satellites. Series-produced observation satellites with remote transfer of images were also developed in the former USSR. A civilian version of that satellite, developed at the All-Union Scientific Research Institute of Electric Machine Building and known by the name of Resurs O, is expected to be



Meteor-3m satellite in assembly area

placed into orbit by the Zenit launcher about once every two years. That satellite can remain active in an orbit 650 km high for up to three years, transmitting photo-information back to clients on a timely basis.

Yet another satellite that, according to RSA documents, is to be placed into orbit before the end of this year is meant

for studying and observing the maritime areas of our planet and the ice conditions. Although the launch will be the seventh of an Okean-type satellite, it may be the last, because the chief supplier and designer of the vehicle—the Dnepropetrovsk KB [design bureau] Yuzhnoye—is having serious problems financing the project. Despite the fact that the government of Ukraine is, in principle, interested

in operating national-economy satellites, it is having a very hard time seeing the benefit that monitoring the North Sea route, for example, has for the internal needs of the new state.

In the event that the Okean project suffers a premature death, RSA may be trying to incorporate its science instruments into the payloads of surviving satellites.

At least two other Russian projects in the area of Earth research are skidding because of financial uncertainty. An ill fate literally haunting the Almaz program, which had its origins in the 1960s in a project of the same name involving a military orbital station developed by the design bureau of Academician Chelomey (now the NPO Mashinostroyeniye in Reutov, in Moscow Oblast). After a premature cessation of the flights of the Almaz as a manned station, the specialists of the manufacturing firm redesigned the vehicle into a satellite for radar mapping of the Earth's surface. Two unmanned Almazes, launched in 1987 and 1991, demonstrated their capabilities marvelously. The experience garnered from them served as the basis for the design of a new, more advanced, better equipped station. But hard times came along, and state financing of the project virtually ceased. Officials at NPO Mashinostroyeniye used their own resources to try to, if not launch Almaz, at least keep it afloat. Photographs made by earlier Almazes were swapped for the money needed to continue operations, netting for the designers some \$100,000. As of today, the paper design of the Almaz is practically finished, and the final documentation for the project is expected to be released in June.

On paper, the Russian Space Agency is supporting the Almaz program, but the 40 million rubles [R] promised this year by the space department remains little more than a promise. The designers are placing some hope on the enlistment of commercial partners, including partners from abroad.

If events develop along an optimistic course, a Proton launcher in June or July 1994 will place an 18-ton Almaz into an orbit 400 km above the Earth. Orbital inclination of 73° to the equator will enable the station to image virtually any point on the Earth's surface regardless of weather conditions or time of day, produce stereoscopic images of terrain relief, and even—with penetrating radio waves—peep beneath desert surfaces and through the dense canopies of forests. Over a minimum of three years of operation, Almaz will accumulate information on infrared hard magnetic disks and, as soon as it is needed, will "toss" the information to its commercial clients throughout the world. In the words of Vladimir Vetrov, deputy general designer of NPO Mashinostroyeniye, the commercial price of the station's services will be an order of magnitude lower than the cost of space.

In a luckier situation than Almaz is the project involving the Priroda module, which is to dock with the manned orbital Mir station module as part of the station, perform studies of the natural resources of our planet. The module is almost manufactured now, and, as the specialists say, they need about 100 cables" to effect the program. Now RSA representatives are giving people to understand that the Russian Academy of Sciences and foreign developers of science gear on the module have shown an interest in its launch, so that the launch may take place in 1994. At the same time, the Spektr module, built along with the Priroda and filled with gear for sensing the Earth in the context of a program of the Ministry of Environment of the former USSR, remains sponsorless despite the fact that it is almost ready for launch.

In strategic terms, the planned Mir station and its special-purpose modules are justified by our space department as a testing ground for gear that, in the future, is to operate on series-produced unmanned vehicles. Raising the quality of science instruments for satellites and creating new such instruments have been declared as one of the key goals of RSA. At the same time, RSA officials emphasize that the agency in the next few years will avoid designing fundamentally new national-economy satellites.

Advantages of Joint U.S.-Russian Space Station Project

937Q0175A Moscow *SEGODNYA* in Russian
No 29, 29 Jun 93 p 7

[Article by Mikhail Chernyshev: "Space Alliance of the United States and Russia"]

[Text] The United States is experiencing considerable monetary difficulties in constructing the Freedom orbital station, as already reported in *SEGODNYA*. The White House has proposed that NASA reduce the earlier intended expenditures of 31 billion dollars by approximately two-thirds. American scientists, in order to save the project, have turned to their Russian colleagues for assistance. The Freedom, which was conceived by designers as a gigantic structure 106 m long, has been "compressed" to an extremely modest size and it looks like it will be docked to the Russian Mir-2 station.

An unexpected variant of a solution for the financial problem appeared, as reported by the NEW YORK TIMES, due to the initiative of two Russian organizations—the Russian Space Agency (RSA) and the Energiya NPO. Billions of dollars can be saved, reason the authors of the project, if the efforts of the two countries are combined in order to implement a program for a "common high-quality orbital station." What would the international space station look like?

The "improved version" of the Russian station, judging from everything, is the same 20-ton base unit put into orbit by the Proton booster. Such modules have been used in the cosmonautics of our country since the early 1970's. Three Western laboratories also will be docked to one of them. Already in 1997, using the capabilities of such a station, three astronauts could be at work in orbit, and at the turn of the century, after the complex has taken its final form, the crew would increase to nine persons. It is proposed that the Western modules be put into orbits by American "Shuttles" and the West European Ariane rocket.

In the opinion of American specialists, such use of Russian technology would enable NASA to save 6-9 billion dollars. This variant also is advantageous for Russia because it is tied in with the purchase of some types of Russian equipment with hard currency. At the Energiya NPO they probably feel that something will be earned from use of our Soyuzes and joint docking units.

"In the evaluation of the commercial possibilities of our cosmonautics," says Aleksandr Medvedchikov, deputy general director of the RSA, "we have passed through the euphoria stage. We thought: we will open up the secret enterprises, we'll put all the best up for sale and foreign buyers will rush to acquire it. Alas, no one rushed forward. Everyone is looking out for his own interests. The United States, Western Europe and Japan are striving to guarantee jobs primarily at their

own companies. At one time we figured that the Mir-2 would be a large international station. Cooperation would make it possible to gain solid clients and repay a considerable part of the costs. This has not happened. But joint work—even under curtailed projects—must be continued. Talk about the possible profitability of space must end. It does not pay for itself in a single one of the well-developed countries. A minimum of 85 percent is subsidized by the government..."

"However, for the time being money is being allocated from the budget, as before, for the Energiya and Buran. But only to keep the space vehicles in a mothballed state. The enormous launching complexes and the oxygen and hydrogen plants built for supporting flights are at a standstill. No one knows what to do with them."

Military Not Receiving Fair Share of Profits From Space Program

937Q0175B Moscow *TRUD* in Russian 13 Jul 93 p 1

[Article by Viktor Badurkin: "In Space, For Profit"]

[Text] It is no secret to anyone that the Russian space program, including its military part, is on the verge of financial collapse. And this despite the fact that in many directions the Russian space industry occupies a leading position in the world.

In the opinion of Pavel Grachev, Minister of Defense, these advantages may bring our country more than a little economic gain if they are used reasonably. As an example he cited the long-term Russian-French program. However, the system for distributing the receipts of hard currency, especially from the filling of orders from third countries, is such that the lion's share of these sums goes to the Russian Space Agency, although most of the expenditures related to the training of cosmonauts and flight technical support were made by the military space forces.

With respect to the future of Baykonur, Pavel Grachev declared that the cosmodrome should be recognized as a Russian military space base or center because Russia's share in financing this facility is more than 90 percent.

Report on Russian Contract for Inmarsat Launch in 1995

937Q0173A Moscow *MOSCOW NEWS* in English
No 22, 28 May 93 p 8

[Article by Anatoly Tkachenko; first paragraph
MOSCOW NEWS comment]

[Text] In late April the international organization INMARSAT and the Russian designing office Salyut signed an unprecedented contract for launching with a Russian booster a satellite built in the West.

The contract which costs 36 million dollars provides for launching in 1995 from the Baikonur space centre

of the satellite INMARSAT-3 with a Proton launch vehicle. Olof Lundberg, INMARSAT's Director-General, and Dmitry Polukhin, Director-General of the Salyut designing office, who signed the contract, are optimistic about the future despite the unpredictability of the economic situation in Russia and its newly independent neighbours. Their optimism is based on the readiness of the European Bank for Reconstruction and Development to grant the necessary funds, the world standards of Russian rocket makers and also the fast growing demand for services of satellite communication, especially on the part of major concerns engaged in transport services and the development of deposits of energy resources and valuable mineral raw materials.

Mr. Lundberg stressed that the contract reflects the confidence of Western firms specializing in communications in Russian technology. It also opens the way for other contracts for launching satellites and for greater commercialization of the Russian aerospace industry as a whole. The latest circumstances have heightened the interest in the project on the part of many Russian design offices, enterprises and organizations which are linked with the rocket-building, aircraft and radio engineering industries. It should be noted that INMARSAT undertakes, besides the cost of launching its own satellite, to contribute several million dollars to ensure the compatibility of the vehicle to be launched with the support services and possibly to bear other expenses due to the lack of experience of such launches. Many Russian design offices and enterprises certainly count on concluding profitable contracts with INMARSAT, which is particularly important in connection with the growing danger of reduction of work places in such sectors of the Russian economy that used to prosper. In this way the space industry alone lost in 1992 about 30,000 development specialists and about 40,000 workers.

Mr. Hadem, INMARSAT's financial director, told MN about a firm financial position of his organization and the constant growth of orders for its services. The ramified network of INMARSAT stations includes stations in Nakhodka, Vladimir and Odessa. Since the mid-80s the Russian Federation has been making terminals of the INMARSAT-A system which are used for satellite telephone communication and transmission of data. At present about 1,600 terminals of this type are used in the CIS countries.

The design office Salyut won the competition organized by INMARSAT for placing with the help of a Proton launch vehicle of the 4th INMARSAT satellite to what is known as the fourth altitude (about 600 kilometres), which makes it possible to count on high-quality and reliable communication given a large selection of free frequencies. In other competitions the right to launch the first two satellites INMARSAT-3 was won by the General Dynamics (USA) and the third one by Arianespace (France). Olof Lundberg believes that the use of launch vehicles of the United States, France

and Russia will make it possible to put each of them through a practical test and also to pool the efforts of the leading countries, including the CIS, in the development of telecommunications.

The use by INMARSAT of the Russian booster Proton is a practical confirmation of experts' opinion that the space industry can bring Russia a substantial income. Yuri Koptev, Director-General of the Russian Space Agency, has calculated that it may amount to 200-250 billion dollars a year. The expenditure will also be considerable; 32 billion roubles will have to be spent this year for the upkeep of the Baikonur space centre, which includes Kazakhstan's contribution. The international organization of mobile satellite communications INMARSAT with its headquarters in London provides mobile communication services at any place in the world. It consists of 67 countries, including Russia. INMARSAT's services are used by practically all shipping companies, more than 100 airlines and hundreds of other firms doing business in hard-of-access and remote areas.

In 1993 INMARSAT puts into operation two new systems, INMARSAT-B and INMARSAT-M. The first one will support terminals and services similar to those rendered today by the INMARSAT-A system. The task is to ensure high efficiency and economic effect with the help of digital methods of communication. The aim of the second system is to provide telephone and fax communication, the reception and transmission of data with the help of an inexpensive compact terminal the size of an attache case, which will be practically the world's first portable satellite telephone that will cost 15,000-18,000 dollars.

In order to participate in INMARSAT competitions an enterprise or organization should apply directly to its headquarters. Before that it is advisable to inquire for INMARSAT's materials about future projects.

Russian Space Program Relying on International Collaboration

93Q0172A Moscow IZVESTIYA in Russian 6 Jul 93
First Edition p 2

[Article by Boris Konovalov, IZVESTIYA correspondent: "Russian Cosmonautics is Trying to Survive by Internationalization"; the first paragraph is an introduction]

[Text] Experiments under the "Altair" project have taken place aboard the Russian Mir orbital complex. After successful docking of the Soyuz TM-17 ship Vasiliy Tsibleyev, Aleksandr Serebrov and Jean-Pierre Enere proceeded to joint work with the crew of the main expedition—Gennadiy Minakov and Aleksandr Poleschuk. During the 18 days of work of the Soviet-French crew almost 20 experiments will be carried out with the participation of the French astronaut.

The "Altair" project is one of the four which are being implemented by France and Russia on a commercial basis. This line has now become one of the key directions in the strategy of Russian cosmonautics, which is now experiencing difficult times. Russia is trying to proceed from purely scientific cooperation to commercial and technological collaboration. This is very difficult because the COCOM restrictions, the political barriers, as before restraining cooperation, are still in force. But the Russian Space Agency (RSA) is displaying stubbornness and persistence because the difficulties with national financing are increasing.

The international Mars-94 expedition, for which France made a balloon and a number of scientific instruments, is now endangered with being scrapped. Despite the fact that the RSA has given priority in budget financing to this project, the receipt of the planned sums is being held up. The Lavochkin NPO is unable to settle accounts with its subcontractors, which is dragging out the work, but the astronomical times for a launching are rigorously fixed. And now negotiations are proceeding for the West to provide direct financial support for implementation of this project.

France was the first capitalist country which began space cooperation with us. It also became the first country which is paying for the work of Russian space specialists conducting a joint project. The Granat satellite was launched in December 1989 and carried the French Sigma gamma telescope. It was planned that the experiment would last 8 months, but the satellite and scientific instruments are still in operation and now this long-lived equipment has become a financial burden for the flight control service. However, the French side has now allocated money in order that Russian specialists monitor the Granat space vehicle until its lifetime has elapsed.

The long-lived Mir station, launched on 20 February 1986, also is causing serious problems. Many systems require serious repair. And now the RSA is conducting negotiations with NASA on joint work for lengthening the lifetime of the Mir orbital complex. If an agreement is reached two long-term flights of American astronauts will then take place aboard the Mir. These flights will be paid for by the United States. Negotiations also are being carried on concerning the placement, on a commercial basis, of American scientific instruments aboard the future Priroda module, which should be docked to the Mir orbital complex.

The European Space Agency also is not standing to one side. Plans call for two flights of European astronauts aboard the Mir, also with payment in hard currency.

The Canadian Space Agency is conducting negotiations on flight of its its astronaut in the Mir. The creation of the Sovcanstar Russian-Canadian communications satellite is in full sway.

Canada, Japan and unified Europe, taking on themselves a substantial share of the financing of the future

Freedom orbital station, have spoken out for the participation of Russia in its creation. Now it only remains to resolve the political disagreements between the United States and Russia resulting from the contract with India for constructing the hydrogen stage for an Indian booster. These disagreements became one of the reasons for calling off the visit of V. Chernomyrdin to the United States. But now in Moscow there is an American delegation for continuing negotiations on the large-scale entry of Russia into the space services market. It is possible that a compromise will be found. This, to be sure, would considerably ease the position of our space branch. But for the time being it is still demonstrating to the entire world its reliability and enormous potential.

After the Soyuz TM-17 ship docked with the Mir orbital complex the main hall of the Flight Control Center, overfilled with guests, burst out in applause. This was a sign of respect to the people, who despite all difficulties, beautifully perform their mission.

Commentary Notes Cancellation of Rocket Deal With India, Possibilities for Collaboration With U.S.

93Q0167A Moscow TRUD in Russian 6 Aug 93 p 3

[Article by Vissarion Sisnev, TRUD correspondent, Washington: "Together to the Stars. The Conflict is Being Transformed Into a Partnership"]

[Text] A visit of a group of our engineers and cosmonauts to the United States was preceded by several weeks of hard discussions behind the closed doors of the State Department and other lofty departments in Washington. First one Russian delegation at the governmental level, then another, persistently sought a compromise which would make it possible, without offending our long-time trading partner India, to adhere to the obligations of Russia under international agreements and maintain the mutually advantageous relations with a new partner, the United States, which are beginning to take shape.

As is well known, the stumbling block was the deal with India under which we supplied it not only with powerful rockets, but also with the technology for their production. With the constant insufficiency of hard currency those 200 or even 300 million dollars which it would bring in unquestionably would not be too much. However, the Americans insisted, and not without basis, that there would be a violation of the agreement on the nonproliferation of the technology for the fabrication of intercontinental missiles. As it turned out we had to agree with this and call off the second part of the deal. It would not be some abstract Russian-American relations which would suffer from obstinacy in this case, but instead our long-term material interests, not to mention our reputation for adhering to international agreements. Everyone will gain from the compromise reached in Washington.

For what reason will our specialists be in Washington? In order, in collaboration with our American colleagues, to work out a long-term plan for cooperation in space which should be ready for examination by the governments of the two countries by 31 August. It is proposed that during the next five years, following the example of the Soyuz-Apollo experiment, there will be new joint space flights during which American multiply reusable ships, the "Shuttles," will dock with the Russian Mir orbital station. The first rendezvous is planned for 1997.

Unofficial, but entirely reliable sources have informed journalists that NASA, the American space agency, in accordance with an agreement, will spend for Russian cooperation at least 100 million dollars a year over a four-year period. A White House representative stated that this should not be regarded as compensation to Russia for what it is losing on the scrapping of the deal with India, but that there was "just a happy coincidence in time." However that may be, it is pleasant to realize that while adhering to the assumed obligations we still will make a good profit on our space technology, which, as the Americans acknowledge, in some cases has moved far ahead.

With respect to possibilities in the more remote future, it has already been calculated that the use of Russian rockets instead of "shuttles" for linkup with the planned American space station will make it possible to save a billion dollars each year. And since D. Goldin, NASA administrator, deemed it necessary to emphasize that cooperation with the Russians will be organized strictly in accordance with the "advantage-disadvantage" principle, it is evident that precisely this circumstance played the principal role in a statement by G. Brown, chairman of the Space Committee of the U.S. House of Representatives: "It's 2 to 1 that Russia will become a partner in an international program for creating a space platform."

Rockwell Contract With NPO Energiya for Docking System for Mir-U.S. Shuttle Mission Reported

937Q0167B Moscow RABOCHAYA TRIBUNA
in Russian 9 Jul 93 p 1

[Article by Aleksandr Pakhomov, ITAR-TASS correspondent: "'Energiya' in an American Orbit"]

[Text] The American Rockwell International Corporation has concluded an agreement with the Russian Energiya NPO on acquiring a docking system which would be used in a linkup between the American Shuttles and the Mir space station. As reported by official representatives of Rockwell International, the

total value of the contract is 18 million dollars, which includes the basic cost of the system, spare parts for it, as well as the technical services of Russian specialists in ground and flight tests of the docking units.

According to NASA plans, the first docking of the Atlantis multiply reusable spaceship with the Russian Mir orbital station should occur in 1995. Rockwell International and the Energiya NPO already have experience with such cooperation: it was precisely they which ensured docking of the Apollo and Soyuz ships in 1975.

'Kometa' Association Appointed Lead Organization for Satellite Telecommunications System

937Q0167C Moscow ROSSIYSKIYE VESTI in Russia
No 137, 20 Jul 93 p 3

[Article by B. Yeltsin, president of the Russian Federation, Kremlin, Moscow: "Organization of a Satellite Telecommunications System"; text of decree No 1020, dated 7 Jul 93]

[Text] In order to establish a satellite telecommunications system for meeting the needs of the population, governmental and commercial organizations of the Russian Federation and broadening their access to worldwide information resources by means of conversion of national information space systems, I decree:

1. Approval of the proposal of the Kometa Central Scientific Production Association that as the lead organization, in collaboration with interested state enterprises of the Russian Federation, Russian and foreign commercial organizations making investments, it implement a project for a Satellite Telecommunications System (hereafter designated STCS).
2. It is deemed necessary that work on organization of the STCS be directed primarily to further development of the communication system of the European part of the Russian Federation, the regions of Siberia and the Far East, the cities of Moscow and St. Petersburg.
3. The Council of Ministers and the Government of the Russian Federation will cooperate with the Kometa Central Scientific Production Association in implementing the STCS project, including the placement of its surface components at the sites occupied by facilities set free due to the reduction of armaments and by conversion.

The Ministry of Defense of the Russian Federation on a contractual basis will supply the technical means for the launching and control of STCS satellites without reducing the military capabilities of defense systems.

Baykonur's Problems Still Unresolved
937Q0162A Moscow DELOVOY MIR in Russian
30 Jul 93 p 15

[Article by Mikhail Rebrov, colonel: "Storm Clouds Over Baykonur. A Time of Alarms and Hopes for the First Cosmodrome on the Planet"; the first three paragraphs are an introduction]

[Text] This summer stood out at Baykonur with heat and unusual raininess. Heavy storm clouds obscure the horizon, slowly float along, pouring down streams of warm water. Then it clears up and green colors, unusual for these times, enliven the endlessly hilly plain.

Other storm clouds hover over the cosmodrome, casting a dismal shadow, an alarming hopelessness. The sun does not break through them, the hot steppe winds do not drive them away...

The first cosmoport on the planet. How much is associated with it! The launching of satellite No 1, the triumphal launching of Gagarin; from here were laid out the first trajectories to the moon and the planets; from here the Molniyas, Meteors, Soyuzes and Salyuts were sent into their orbits... Baykonur has acquired a planetary reknown. That is a fact.

Thirty-seven years have already passed since the first stone was laid at test range No 5 of the Ministry of Defense of the former USSR in the desert not far from the small out-of-the-way station Tyura-Tam. Within a relatively short time, through the efforts of military builders, a closed city arose here which was given the name Leninsk. At Baykonur there are more than 1200 facilities and structures. If one speaks of the cultural sphere, the military constructed in the city not only residences with a total area of a million square meters, but also ten schools and more than thirty preschool institutions; in Leninsk there is a technical school, an affiliate of the Moscow Aviation Institute was opened, there is a military hospital and a city hospital...

The birth of such a large city naturally required the construction of a thermoelectric power plant and bread factory, the laying of hundreds of kilometers of water, heat and sewer lines. Today it is difficult to speak of the value of the fixed assets; inflation is changing ordinary concepts and in addition, many engineering structures are in an extremely deplorable condition and require major repair. Climate and time take their toll.

During the past years eight chiefs have taken their turn at the cosmodrome. Now it is headed by a ninth, General A. Shumilin, who began his service as a tester in the launching detachment. Everyone was called in to get acquainted, there were many meetings and conversations, frank talks, far from official slyness and propagandistic hoopla. They also assisted in analyzing and

understanding much at the heart of that heavy work which fell to the lot of the military.

The following document exists: "Agreement Between the Republic of Kazakhstan on Procedures for Use of Baykonur Cosmodrome." It is dated 25 May 1992 and stands alongside many reasonable resolutions. We admit: there are now plenty of "paper" agreements around. But today there is no mechanism for their implementation. The fact that the implementation mechanisms for us are jammed up is a happening which, unfortunately, is commonplace. So in what way then is this unusual?

It is possible to mention many things. Both the calamitous situation in a city deprived of its usual underpinnings, resulting from the aging and destruction of its facilities, aggravation of conditions conducive to criminal activity and a total lack of confidence in tomorrow among those who bear all the rocket-space concerns on their shoulders. Hence the waves of migration...

Among the great many realities of everyday life I will draw attention to only one, which, indeed, is the most alarming. The once prestigious service assignment is today scaring away young officers. "Mutinies" of soldiers, acts of arson, failure to punish hooligans, pilfering of everything, and all these things are aggravating the situation. Understaffing in all subdivisions is threatening to cut off implementation of important space programs.

A lot is being said about the present-day situation and the most different opinions are being expressed: both about the "claims of Russia to Baykonur" and about the "intractability of Kazakhstan" and about the "absence of a healthy approach." Who is right, and how so, and who is wrong? It's hard to say right off. But it is impossible to remain silent today: people are suffering, things are going to pot.

The position of Kazakhstan can be understood: the sovereignty of the republic, the aureole of universal glory, they say that the famous cosmoport is on our lands. But we will be objective. Today only Russia is in a position to carry out large-scale space research (I emphasize: by itself). The Ukraine has plants where satellites and rockets are made, but it has no cosmodrome. Kazakhstan has no space industry; it does not have that scientific base and experience which we have. I will not mention the other republics, although they have invested a definite part of the sums to this branch and it is only right that their interests be protected.

All this is true. But let's visualize for a minute that Russia withdrew from Baykonur, leaving everything behind. Is Kazakhstan capable of independently operating, let's say, the highly complex Energia-Buran launching complex, the Proton and Soyuz launch pads (incidentally, among the four Proton launchings only

one is functioning and its guaranteed lifetime has already been repeatedly prolonged? No, the republic is not capable of this.

"It is with bitter regret that it must be stated that until now neither the Academy of Sciences of the Republic of Kazakhstan with its branch institutes, nor the Ministry of Science and New Technologies ... nor the Ministry of Defense, nor all the other republic ministries and departments, are manifesting any interest in the scientific and industrial potential which has been accumulated here by the most leading, most progressive ministries and departments, industrial and scientific enterprises of the former USSR."

Such is the frank admission of the present-day administration of the city of Leninsk. An absurd situation is developing. Some are like inert and indifferent, others (Russian Space Agency, military-space forces of the Russian Ministry of Defense, industrial and scientific associations of the Russian Federation), on the contrary, are not interested simply in the preservation, but also the development of Baykonur. But how to share that which was created through the efforts of all? There is no clear answer to this question. Boris Dmitriyevich Ostroulov, the deputy general director of the Russian Space Agency, said to me: "There won't a future if it is not taken into account that the launching complexes, command-measurement points, computer centers, electronic systems, torn from the general infrastructure, are no more than costly assemblies not having any use. The same can be said of the space industry if it is deprived of orders. It therefore follows that there must be reasonable business approaches, cooperation."

Without question a definite percentage of the sums from operation of the gigantic Kazakhstan test site must be taken primarily for improving the social and living conditions at the cosmodrome and in the city. But there is something else which is indisputable: Russia and the other republics have their interests here. That must be the point of departure.

But there's more. Nothing happens without money. But who will invest money if there are no firm guarantees and effective agreements? And, indeed, according to the norms generally accepted in the civilized world, whoever invests money in the development and construction of any facilities and structures should (such is the law!) have them at his disposal.

Unfortunately, the very concept of the law is interpreted differently. "...Perhaps it can be considered normal... when in the truly Kazakhstan city of Leninsk there is a passport and pass system in the city and at the facilities at Baykonur cosmodrome which is under the control of internal affairs agencies and the army of the Russian Federation...? Such is the position of Kazakhstan and the local institutions of self-government. In the present-day situation there cannot

be two opinions concerning the passport system in the city. With respect to property, however, the logic here is entirely different.

I have had the opportunity to visit many closed cities, military proving grounds, test centers and other permanent facilities. There they have their rules and regulations which are more rigorous than at any other place. Guards, passes and rules for work with documents, especially secret documents. And no one is surprised by this, no one grumbles. Why, let's say, should outside civilians, not having any business there, just wander around the area occupied by a military unit? Why there, where there is a concentration of the most modern weapons and equipment or where their development is in progress, should there not be secrets? Exactly such a regime has been established at special facilities in the United States, Great Britain, France and Germany. There are both passes and restricted paths of movement, and in general forbidden zones behind barbed wire, and a special security warning system.

I really do not want, as they say, to pour oil into the flames. But it seems to me that the reason for all the misfortunes of the city and the cosmodrome is that until now Russia has not received firm guarantees for its activity in facilities of the space infrastructure, the right of use, ownership and control of even one facility has not been legitimized. But as long as indefinite ownership prevails it will give rise to plundering, squandering, ruination and even annihilation of unique space facilities.

I recall the words of Nursultan Nazarbayev: "It is possible to build customhouses on the Earth, but that is impossible in space. Baykonur was and will be the property of all peoples of our country. Sooner or later it will become a factor bringing peoples together because even the richest countries are in no position to investigate space alone."

A wise point of view, no doubt about it. The same, however, as there is no time for dragging out uncertainty. Dallying may lead to enormous losses: for Russia, for Kazakhstan, for everyone...

What matters require urgent solution by all interested parties? I will risk mentioning only the most important. First of all it is necessary to make a decision about the status of the troop formations of the Russian Federation which are stationed in the cosmodrome area, to come to agreement on guarantees of the rights of ownership, the privatization of facilities and the formation of joint stock companies; on the staffing of subdivisions; on the financing of the maintenance and operation of cosmodrome facilities; on the principles of fractional participation of the parties; on support of law and order and safety in the city and at the facilities; affirmation of the principles for operation of residential quarters and a plan for social development of the city at least up to the year 2000.

On the eve of the launching of the Russian-French crew a working meeting of a representative of the Council of Ministers of the Government of Russia, O. Soskovets, the Minister of Defense of the Russian Federation, General of the Army P. Grachev, and the head of the government of Kazakhstan, S. Tereshchenko, and the head of the military department of the republic, General of the Army Sagadat Nurmagambetov, was held at the Baykonur cosmodrome. A number of specific proposals were expressed on the Russian side. Unfortunately, the negotiations were very brief.

We will await a new stage in the negotiations. An agreement on organizing expert groups for reconciling points in dispute has been reached. This gives reason for hope.

Military Space Launches Continuing at High Rate Despite Decline in Space Sector

*937Q0157A Moscow NEZAVISIMAYA GAZETA
in Russian 13 Jul 93 p 6*

[Article by Anatoliy Zak: "Baykonur: Instants of Poetry, Decades of Prose. The Misfortunes of the Cosmodrome Were Caused by the Crisis in the Branch Giving It Birth"]

[Text] You never can get used to this spectacle. Every time an orange flame and a sinister rumble arise like from the very heart of the booster rising above the steppe and the hundreds of witnesses literally freeze in a hypnotic numbness. Only a long 530 seconds later, after the passionless voice from the loudspeaker gives the word that a new spaceship has entered into orbit, does the consciousness of the witnesses to the launching return to normal. Thus it also was on this occasion when the "Soyuz TM-17" spaceship with a Russian-French crew was launched into the cloudless sky in the light of the evening, but still hot Kazakhstan sun.

After successful entry into orbit the new crew began to implement its flight missions, at the same time that those accompanying the crew at Baykonur had to return to their terrestrial tasks. And it seems that there are more problems at our main space harbor than there are in orbit. During the 38 years elapsing from the time of laying of the first stone in the Kazakhstan steppe the city-cosmodrome has certainly never been in such a critical and uncertain situation.

The air temperature, on these days attaining +43°C, very much resembles the heated local political atmosphere. Because until now no working formula has been found for the interrelationships between Russia and Kazakhstan in control of the launch site and something like a double authority has come to pass in the city. Disputes between the Russian military space forces and the city administration, politically subordinate to Kazakhstan, arise at every step, beginning with

separation of the responsibility for supplying the population with food and ranging through the sharing of profit from commercial launchings from Baykonur.

The mayor of the city of Leninsk (which, by tradition, is the name given to the residential zone of the cosmodrome) V. Brynkin, recently named to this new post by the president of Kazakhstan, states that the Russian military and financial organizations are with increasing frequency pushing forward the thought of their sovereignty over the cosmodrome on the basis that Russia is bearing the principal costs for maintaining the launch site. However, the cosmodrome has been formally nationalized by Kazakhstan. The expenditures of the new sovereign republic on city maintenance this year are 11 billion rubles, whereas the entire municipal economy in Leninsk requires 19 billion rubles per year. On his part V. Brynkin accuses Russian financial organizations of being unwilling participants in supporting the municipal economy, as a pleasant exception mentioning the decision by Yu. Semenov, the general designer of the Energiya NPO, to allocate 150 million rubles for these purposes on a one-time basis.

The two sides have extremely different opinions concerning the juridical status of the world's largest space harbor. The leadership of the military space forces insists that Baykonur must be nothing less than a military base of Russia in Kazakh territory where everything but the land belongs to Russia. However, Kazakh officials hint that in this case the republic will require payment for the leasing of the enormous areas occupied by the launching complexes and the areas of falling of spent rocket stages.

The Kazakhstan government and the Supreme Soviet would like to see Baykonur an intergovernmental or possibly an international joint stock company of the open type, controlled by all participating parties as equals. Kazakhstan also would like to receive 15 percent of the profit extracted by Russian organizations from commercial launches like the recent Russian-French flight. On the day of its beginning negotiations were held between the ministers of defense of Russia and Kazakhstan and, in their own words, some agreement was worked out making it possible to resolve many contradictions.

While the politicians are arguing, the city is the scene of ever more frightful evidences of decay. Already entire homes, abandoned, looted and burned, lay open with broken windows and construction cranes stand idle over uncompleted sociocultural structures. In the city there are now about 2000 empty apartments and the population of the city has dropped by 21 000 persons from the more than 100 000 only five years ago. There has been an increase in crime inversely proportional to the decrease in the number of police and the stress between the Russian and Kazakh communities, until recently almost completely separated, is increasing. In a desperate attempt to compensate for

the insufficiency of conscripts for immediate service at Baykonur the military space forces have announced the selection of conscripts on a contractual basis and the first such military personnel have already taken up their posts at the cosmodrome.

The local climate is creating enormous problems for the inhabitants of the city. Whereas at the launching complexes enormous premises with controlled temperature and humidity have been constructed, in Leninsk itself the clients of dining facilities and shops are suffering from the oppressive heat and unpleasant odors. In many private apartments there are air conditioners, but their occupants risk the electricity cutting off when this equipment is switched on. The water supply system in the city also operates with incessant interruptions, not to mention the quality of the water itself. Experienced journalists, upon arriving in Baykonur, boil the water even before brushing their teeth.

Rephrasing the well-known advertising cliche, it can be said that the prices in the city are above the market prices. These days a resident of Baykonur, finding himself in the street, must select between the 40-degree heat or a bottle of Pepsi for 2000 rubles.

Without question the misfortunes of the city have been caused by the crisis in the branch for which the city was established and has existed. The "Buran" program became a real symbol of the shock which our national cosmonautics has experienced. A good many weeks ago an official decision was made to shut down the project. This was essentially only a formal ending to the process of dying of the "Buran" program, beginning soon after the first and only flight of the Soviet multiply reusable spaceship in 1988. Today the launching facilities of the "Energiya-Buran" system are a pitiful sight: the almost unpopulated assembly-test buildings with gigantic "Energiya" boosters frozen in different stages of assembly and shuttle ships shrouded in their "berths." The Cyclopean launching structures also are lifeless, giving the appearance of bottomless caves of waste gases filled with ground water which is turning green and tracks with the width of a soccer field overgrown with grass. The few officers working here say that many elements of the launch pads are being looted or are becoming worthless.

Yu. Semenov, the general designer of the Energiya NPO, also visiting Baykonur at this time, stated that efforts will be undertaken for preserving the technical base of the "Buran" program in order that it be used for other programs. In particular, reference is to the "Energiya M" program, constituting a downsized version of the "Energiya" booster with a payload of 30 tons. According to Yu. Semenov, the new rocket will be

able to participate in operations for launching of elements of a Russian-American orbital station, and also will become a carrier for a promising downsized version of the Russian shuttle. In any case this most likely will be an undertaking for the next century, not the current decade. For the time being, however, the launch pads are rusting under the open sky.

Nevertheless it seems that not all space programs are in such a sorrowful state. However paradoxical it may seem, the crisis of the social and everyday living sphere at the cosmodrome and the acute economic situation in the country in general are not hindering the Russian military from a buildup of space activity. The complaints of the generals about a reduction in the military budget in favor of civilian programs stand in contradiction with a whole series of facts. Twelve Russian military satellites were launched into circumterrestrial orbit during the first quarter of 1993 alone. These included three navigation satellites, two communication satellites, two photoreconnaissance satellites, two satellites for early warning of launchings of ballistic missiles, two electronic surveillance satellites, and finally, a new marine reconnaissance satellite. During this same period only six Russian space vehicles were launched for civilian purposes. As a comparison, during this same time interval a total of eight satellites were launched in the United States. In a recent report to the American congress General Charles Horner, a representative of the USAF space command, stated that "the recent actions of the Russians show that the former USSR is maintaining a surprisingly high military activity in space." The representatives of the Russian Space Agency also have repeatedly hinted that development work is proceeding in the country on a gigantic new-generation reconnaissance satellite.

Questions are arising among many observers throughout the world as to why the Russian Ministry of Defense is maintaining a rate of launching of military satellites almost corresponding to the worst times of the cold war and whether the "spitting out" of millions of rubles from Baykonur is justified, whereas a situation prevails at the cosmodrome characterized by many as an evacuation. At the same time, many programs for constructing economy-oriented satellites, such as the project for the "Almaz" radar survey station, "Okean" oceanographic satellite or the "Priroda" module with experimental instrumentation for investigating the Earth's natural resources, are suffering from an acute shortage of financing. It only remains to ascertain whether such an active use of space for military purposes is a feast amidst a famine which is hurtful for our civilian cosmonautics, our cosmodromes, our scientific-technical potential and finally for our invaluable personnel, packing their bags at Baykonur?

Khrunichev Plant, Salyut Design Bureau Merged Into Single Organization

937Q0156A Moscow MOSCOW NEWS in English
No 27, 2 Jul 93 p 9

[Article by Sergei Golotyuk; first paragraph MOSCOW NEWS comment]

[Text] Boris Yeltsin has decreed the merger on the basis of M.V. Khrunichev research and production centre of a machine building plant of the same name, which is a major rocket-space enterprise, and the design office Salyut which has vast experience of building rockets and spacecraft.

The presidential order appeared amid an acute conflict between the design office and the plant. Each of them has for several years acted independently as the seller on the world market of the space services of the launcher Proton (UR-500K) which was developed by the design office and is made by the plant.

The conflict reached such an extent that this year the rocket UR-500K was launched without participation of the design specialists which is required (and has been until recently undeviatingly followed) by the departmental standard. The last of these launchings (May 27) resulted in an accident. While the preliminary analysis of telemetric data does not show that the accident was linked with the absence at the launch centre of representatives of the design office it must have accelerated the issue of the presidential order.

But the significance of the new centre goes far beyond the ending of the conflict. The state sector may be regarded as Russia's first rocket-space firm. During the last few years both enterprises actively searched for a place on the international market. Foreign firms understand the striving of the design office Salyut not to be ignored during the sale of rockets developed by them. The design office has concluded contracts for the development of rocketry with the Indian organization for space research, the German aerospace agency DARA, the firm DASA and with the international organization INMARSAT for launching a communication satellite (36 million dollars).

The M.V. Khrunichev plant has signed a contract with the American firm Motorola (200 million dollars) for three launchings of Proton (the putting into a low orbit of communication satellites) and created together with the corporation Lockheed an enterprise for the sale of its rockets on the world market.

Coordinated actions of the plant and the design office will make easier the signing of new contracts for the launching of foreign satellites by Proton (UR-500K is now taking part in tenders for the launching of satellites of three leading firms which operate international communications—Intelsat, Eutelsat and Asiasat). Every such launching requires preliminary work of the design office for combining the rocket with a satellite.

The chances of an early signing of such contracts can be enhanced by an intergovernmental Russian-American agreement on just commerce under which Russia would have the right to launch 12 American satellites before the end of the current decade.

It is expected that some of the money received from foreign customers will be used to carry out modernization of Proton which was announced long ago but has not yet been performed for lack of funds. As a result, the mass of satellites placed in a geostationary orbit will grow by one-third, the control system will be improved and environmental pollution during launchings will be reduced, which will make the rocket more competitive.

But the unification may have negative results if the contract between the plant and Lockheed corporation (whose text is not published) proves contradictory to the contract between the design office and the Indian Space Research Organization. It is possible that in this case the cooperation with India will be discontinued (which the US administration has been striving for a long time), while Russia's reputation as a reliable partner may suffer. It is hard to say whether it will be possible with the participation of Lockheed corporation to bypass COCOM's restrictions on the import into CIS of high-technology satellites and thus attract more customers than those who would be lost as a result of failure to observe the terms of the contract signed with India.

Russia-Kazakhstan Agreement on Resolving Baykonur Crisis Reported

937Q0155A Moscow NOVAYA YEZHEDNEVNAYA GAZETA in Russian No 16, 14 Jul 93 p 2

[Article by Oleg Volkov; "Baykonur: Grass Seen Through the Window... What's Happening to Baykonur is Bringing It to Desolation"]

[Text] The content of a protocol signed by Oleg Soskovets, Russian vice premier, and Sergey Tereshchenko, Kazakh prime minister, has become known to NOVAYA YEZHEDNEVNAYA GAZETA.

The scheduled meeting of governmental delegations of Russia and Kazakhstan, held early in July in Leninsk for discussing the future of Baykonur cosmodrome, ended with the signing of the next protocol on intentions. This event passed unnoticed, although in the fate of the small Kazakh village and national cosmonautics it may play a role of more than a little importance.

It appears that Kazakhstan no longer intends to nationalize the cosmodrome with all its unique belongings and Russia is no longer threatening the stoppage of capital investments and construction of a new Baykonur in its own territory (considering that there are many provisional sites—at Plesetsk, at Kapustin Yar, in Krasnoyarsk Kray). There is simply no money for adding onto the parade of space sovereignties. To

be honest, there already is too little money even for the joint use of the cosmodrome.

Money also was the subject of the recent Russian-Kazakh negotiations. But this time it was not about the dollar profit from tourism and commercial use of space, to which the Kazakh side at one time had made strong claims. It appears that ways for sharing it have been found, namely through the organization of joint stock companies (consortiums) for ensuring launchings of space vehicles and operation of facilities at the Baykonur cosmodrome.

Instead the sides discussed the means which as quickly as possible must be invested in Baykonur in order to maintain it as a cosmodrome and not as a junkheap of unwieldy equipment. It was agreed: Kazakhstan is to appropriate a little more than 3.5 billion rubles and Russia is to allocate 9.3 billion. Now, judging from everything, both sides are intensively seeking this money...

This meeting, incidentally, facilitated solution of one of the most complex problems—the division of property. Under the agreement the Kazakh State Committee on Properties should convey ownership of the civilian facilities of the cosmodrome to Russian enterprises. This process, which only a year ago would have caused a great stir, this time will most likely take place painlessly. The republic by itself, not having specialized factories and design bureaus of the space branch in its own territory, is unable to maintain the technology in its proper condition. But new facilities (constructed after 31 August 1991) will belong to whoever financed their construction.

Negotiations are going less smoothly with respect to the military facilities located in the cosmodrome territory. In the offices of the Military Space Forces of the Russian Ministry of Defense they assured me that Kazakhstan is not in a position to finance or even to service them. All the officers are Russian. Indicative of the personnel crisis at Baykonur, for example, is the organization of the Main Military Construction Administration, stipulated in the protocol, whose work force will be from both sides (earlier it consisted of Kazakh military personnel). That is why the Russian side, bearing the principal costs, is insistently proposing its version of a foreign military base. Kazakhstan is rejecting this with equal stubbornness because it contradicts the constitution of the sovereign republic.

Nevertheless they assured me that the "process went well" and both sides are preparing documents for a summit meeting between presidents Yeltsin and Nazarbayev, after which they hope in both Kazakhstan and in Russia that the Baykonur cosmodrome will emerge from its "suspended" state.

Interview With V. V. Nekrasov, General Designer for Photographic, Electro-Optical Space Systems
937Q0151 Moscow KOMSOMOLSKAYA PRAVDA
in Russian 9 Jul 93 p 3

[Interview with Viktor Vasilyevich Nekrasov, general designer for photographic and electro-optical space systems, Lenin Prize laureate, twice State Prize winner, 1993 State Prize of Russia winner, by Nikolay Dolgopolov: "From Above, We Can See a Ball on a Field in Arizona: They Didn't Know Them by Sight"; first paragraph is source introduction; first and second parts of interview are separated by three paragraphs of commentary]

[Text] **Viktor Vasilyevich Nekrasov is a Lenin Prize laureate, twice winner of the State Prize, and winner of the 1993 State Prize of Russia. You've never heard of him? That's not surprising. This 62-year-old general designer of photographic and electro-optical systems for space complexes is giving the very first interview of his life.**

Conversation in the Office

[KOMSOMOLSKAYA PRAVDA] In order to represent the scale or, more accurately, the breadth of your activity, I'll ask you about something that is obvious and easy to understand: how many people do you have working in the Central Design Bureau?

[Nekrasov] There were four and a half thousand. Of them, 900 were in the experimental production, so that we ourselves produced the results themselves of the research, without having to turn to anyone else. Of course, there not quite as many of us now.

[KOMSOMOLSKAYA PRAVDA] Are they leaving, as are many scientists, to distant places?

[Nekrasov] So far, God had been nice to us. We have not suffered the kinds of losses that the Academy of Sciences has suffered.

[KOMSOMOLSKAYA PRAVDA] It's probably hard to leave you, right? State secrets have to be kept for years.

[Nekrasov] The restrictions on that particular score have been lowered. But right now, we're opening up little by little to the world, and, of course, that involves some risk. For now, I don't feel any risk, and perhaps that's because we haven't exposed ourselves completely. There is some danger. We're part of the Krasnogorsk Optical-Mechanical Association. Unfortunately, the work being done by our specialists is not, in my view, regarded very highly. True, for those I would call brains, we developed a special system. The leading specialists are still making ends meet. Although for the most talented scientists and designers, it's scant. After all, we alone have more than 40 people who are Lenin Prize or State Prize laureates. Unfortunately, there's only enough for those people.

[KOMSOMOLSKAYA PRAVDA] Right now, the entire military-industrial complex is going through something like that. And if I were to enunciate the three sacred letters, would you tell me what specifically you are producing? Of course, within the limits of what is permitted.

[Nekrasov] We don't just work in the military-industrial complex. We're turning out 500,000 Zenit cameras a year, some of which are exported to 70 countries. That is exactly what is enabling us right now to exist. There's also medical equipment. And of course, military reconnaissance: at first it was airborne systems, then it was space-based systems.

[KOMSOMOLSKAYA PRAVDA] But are you allowed to give us any details?

[Nekrasov] Why not? We worked with the military-industrial complex and the Ministry of Defense as our clients. All the gear that was made in this country for space-based observation systems was manufactured right here. Using the language of politicians and military people, it makes it possible to monitor the state of international military potential across the entire planet. Quantities—that's self-explanatory; and then movements, deployments, modernization. It helped monitor the activity of alleged enemies. We could see what was going on in whatever region he had his rockets in, like in a launch-silo sector.

[KOMSOMOLSKAYA PRAVDA] My gosh, is all that being monitored now?

[Nekrasov] Of course. In early 1992, I was in California, near San Francisco. Here we were traveling around California, and the picture was so familiar to me that I couldn't help but comment on the location of their industrial facilities. The Americans were in shock.

[KOMSOMOLSKAYA PRAVDA] And I can well understand.

[Nekrasov] We got that information with our most advanced optical systems. Imagine a huge tapestry with an extremely detailed street map on it—of San Jose, for example—which my colleagues and I in Moscow made our way around in museum slippers.

[KOMSOMOLSKAYA PRAVDA] Did you weave that tapestry yourselves in Krasnogorsk?

[Nekrasov] That's something the clients themselves do.

[KOMSOMOLSKAYA PRAVDA] But you have the right to look around the tapestry?

[Nekrasov] It's not that we have the right. It's that we have to, so we can evaluate our work and try our best to make it perfect.

[KOMSOMOLSKAYA PRAVDA] Viktor Vasilyevich, forgive my technical illiteracy, but what do you mean by "make it perfect"—isn't that science fiction?

[Nekrasov] Let me put it a little simpler. The clearer a photograph, the more information it contains. Take any photo—for example, a photo of some plant. There may be some details there. Sometimes they not clear enough: they may not tell how many people are there. But our job is something different. The gear must be of the highest quality. The detailing must be such that one could clearly distinguish that General Designer Nekrasov and correspondent Dolgopolov have gone to the TsBK [not further expanded] to inspect the shops.

A Tour of Secrets

We both in a solid hangar that's about 80 x 70 meters. It's 18-20 meters high. This is where they have large, highly precise optical test stands. There are several such hangars at this plant near Moscow. And the first was built here in 1976. It is here that the optical space systems go through their final certification. Everything in the space is constant: the temperature, the air quality, the pressure. The walls are double walls. Between them is an air-filled space one and a half meters wide. The air circulates between them at a given temperature, ensuring absolute thermal stability. The building sits on a foundation of reinforced concrete almost 18 meters thick. The foundation eliminates as much of the vibrational disturbances as possible. But despite that, during the testing of articles, one can feel very tiny vibrations of the earth's surface and the soil, and even the movement somewhere in the distance of a Krasnogorsk bus, and that's picked up. It testifies to the precision of optical space systems and the high-quality characteristics that are evaluated here. The gear is so sensitive that no more than two people can be in the hall when they're working with it. For, as the academician-guide patiently explained to me, the generalist, "body heat affects it. The temperature fields that they radiate affect the precision of the coding. All you have to do is put your hand in front of the instrument, then remove it, and the thermal wave remains."

And it's like a parade of optical space systems passing before my eyes. Beshenov, Minkov, Gerasimov, Ryabushkin. Names that don't mean anything to the Russian people. But it may be that thanks to those brilliant designers, we survived the age of the cold war and crises. Who knows? That depends on one's view of history. Militarists and sponges of the peoples money, or people who preserved military parity? Secretive geniuses who were involved only with the Ministry of Defense? They're the ones who developed the 6.5-m lens for the Salyut station. They developed so much of everything that is being used to this day and will continue to be used for decades and decades. They "taught" the ballistic missiles that were made to be sent across the oceans and the continents to land right

on target. They created the gear that helped solve all the problems associated with the creation of digital maps. And now that information, stored in computer memory, can be sent to the consumer very, very quickly. Determination of the coordinates of a foreign object can be done today with amazing accuracy and is issued in digital form. Sometimes they managed to make things that initially seemed totally unfeasible. Even the specialists from the allied space fields called Nekrasov a utopian. They upbraided him: you don't know what you're talking about. And in fact, what was proposed to them hadn't been confirmed in practice or in theory. But in Krasnogorsk they made things, effected things, and then explained how and on what basis. For example, Nekrasov and his colleagues produced a uniformity in the displacement of film to an accuracy to the tune of 0.005%. Here, for example, is an optical system held together with an openwork case. Viktor Vasilyevich assures us that you couldn't build one any more precise. And the outside looks so good!

Or take another secret experimental platform. It's in gigantic optical telescopes. Like sturdy little mushrooms, they were all over the giant shop. Except that the mushrooms are filled with such advanced equipment that they are capable of performing 12 millions of the most varied commands. Which is why they can monitor near-Earth space. Put simpler, they can detect anything and everything that crawls, swims, or flies in a very extensive geographical region.

But What Do You Do If It Makes It Hard for Everyone

[KOMSOMOLSKAYA PRAVDA] Viktor Vasilyevich, how are you surviving in general? I can easily guess that you barely have enough money.

[Nekrasov] We have what everybody else in the military-industry complex has. We don't feel that any special attention is being paid us or that the proper interest is being taken in us by the state or even by the Ministry of Defense. I don't understand it, because whoever has the information controls the situation.

[KOMSOMOLSKAYA PRAVDA] Viktor Vasilyevich, sir, don't be offended by what I say, but before, you were like a monopoly. Whatever money the military-industrial complex, and you in particular, needed, that's what you got.

[Nekrasov] That's right, in the past we never really thought about money. But I'm not talking about just that right now, I'm also talking about attention. It'd be simpler to say that they just up and dropped us. Today, we're still ahead of all the rest. And we're moving forward, but it's on momentum only. The Americans and others are overtaking us. You think they would up and cut off funding, like we did. Well, you're wrong. And then we have conversion. You have no idea how much we can and want to do for the national economy. And what happens? We sent dozens of the most

specific proposals around to ministries and departments of every kind. You know how many showed any interest?

[KOMSOMOLSKAYA PRAVDA] I can guess. Not very many. Everybody is interested in just their own area.

[Nekrasov] You guessed wrong. Not a single answer!

[KOMSOMOLSKAYA PRAVDA] Viktor Vasilyevich, how about if we talk about something a little happier. What did you receive the Lenin Prize for?

[Nekrasov] Better if I told you what I didn't receive it for. For the 100th anniversary of Lenin's birthday, we made a piece of equipment for the contactless measurement of the geometric variations in the parameters of the body leader in the Mausoleum. The Ministry of Health—the main client—incorporated in the list of competitors the author himself. The promotion got under way, and the work, as you know, was unrelenting in those times. But we rethought it, and decided to abandon it. Somehow it was awkward to talk about a Lenin Prize against the backdrop of the leader's body. So I got the Lenin Prize for something else.

[KOMSOMOLSKAYA PRAVDA] Your whole life, you've been a person in secrecy. Has that affected your morale?

[Nekrasov] It hasn't affected me. I've been occupied with my work, you see, and only my work. Everything else seemed of secondary importance. In 1990—when I was 59—I left my place of work to meet with others. Although at first they introduced me kind of strangely, and I had to ask questions that I didn't want to ask. But still, it was very useful—meeting with colleagues also gives birth to truth, and possibilities become fleshed out. It's too bad that we haven't understood the importance of those meetings until now.

[KOMSOMOLSKAYA PRAVDA] Tell me, did they watch you in any way before that?

[Nekrasov] I never bothered myself with that. That's how I was raised. I know the situation with keeping state secrets and instructions—we still have them—can't do without them. By birth, I'm from Zubtsov. Don't strain yourself—it's a small settlement in Tver province. But it's mine, my hometown. And no matter what or how much changes, I see my work as a duty.

[KOMSOMOLSKAYA PRAVDA] Viktor Vasilyevich, you said that you get masses of the most varied technical information. I'm almost certain that along with the unclassified information, there's some that was gotten by illegal and unfair means. Don't you ever reach that conclusion, if only from the geographical location it pertains to?

[Nekrasov] Where the information comes from I've never analyzed. I'm interested in its reliability, its volume, its multifacetedness, its quality. The channels

it comes through are quite varied. And that's how it is all around the world, I assure you.

[**KOMSOMOLSKAYA PRAVDA**] Viktor Vasilevich, allow me here at the end a very, very dilettantish question. Could you see a soccer match on an Arizona field?

[**Nekrasov**] That's not a dilettantish question at all. We're used to effecting the acquisition of information regardless of the conditions of its environment and regardless of its location in whatever specific conditions. That's our approach. If we say that we need to look at a soccer ball, then we take that to mean that we have to look at the ball regardless of whether it's in the snow, on the bank of a river, on the water, amidst vegetation, or on a field. And in theory, we can do that. But if it's a black ball on a field, then that's something we have to think about. If it's a light-colored ball, then no problem.

Supreme Soviet Working on Space Legislation

937Q0149 Moscow KOMMERSANT-DAILY in Russian
30 Jun 93 p 2

[Article by Aleksandr Sergeyev, under the rubric "Supreme Soviet on Space Activity": "Flights Into Space Will Be Regulated by Law"; first paragraph is source introduction]

[Text] Departmental documents that stipulate the activity now of enterprises of the space complex are technical and cannot be used for solving the problems associated with the property of managing entities and authors rights to technology. In the opinion of parliamentarians, the basis for the legislation being created for the exploration of space should be the Law on Space Activity adopted yesterday in its first reading in the Supreme Soviet.

The need to pass the Law on Space Activity, in the opinion of the that document's developers, stems from the fact that not one single law regulating space activity exists today—even though the industry for the creation and use in the commercial realm of products associated with the rocket-space complex remains one of the few avenues through which hard currency makes its way into the budget. The absence of a juridical basis, noted Aleksey Adrov, the chairman of the parliamentary commission on transport, communications, information science, and space, weakens the positions of the Russian space firms on the international market.

The draft law approved by the parliamentarians must establish the jurisdiction of the organs of executive authority and the rights and obligations of the enterprises in the field of space activity. Specifically, that document stipulates the procedure for government financing of enterprises of the rocket-space complex on the basis of the Federal Space Program. The involvement of foreign capital in space-research projects is

possible on the basis of the allocation to the appropriate Russian managing structures of the controlling block of shares in the projects. At the same time, investors are given guarantees for the capital they invest.

The draft law—which not only stipulates observance of property rights in all stages of the realization of a project, but also determines for the first time the criteria for safety in space activity, including the prevention of ecological damage—has been sent for further work to the committees and commissions of the Supreme Soviet.

[Sidebar]

Main clauses of the Law on Space Activity

- Space activity is performed for the purpose of improving the well-being of the citizenry.
- The Federal Space Program of Russia is the document on the basis of which the state order is formulated.
- The space activity of organizations and citizens is subject to licensing if it includes the manufacture, storage, preparation, and launch of space vehicles.
- Guarantees of foreign investments in the space activity of citizens and organizations can be provided with their money, intellectual property, or other property.

Changes in Russian Space Policy Urged

937Q0146A Moscow MEGALOPOLIS-EKSPRESS
in Russian No 23, 16 Jun 93 p 15

[Article by Aleksandr Radionov, colonel: "Space: Cost of a Cheap Clearance Sale"; the first paragraph is an introduction]

[Text] Caught by surprise by the precipitous nationalization of space structures in the disintegrating Union, Russia initially was taken aback. It obviously had not expected such aggressive and hasty claims on Baykonur, satellite control points and military-space organizations, satellite communication channels and space reconnaissance materials.

However, the free-spending fathers of cosmonautics from the former Ministry of General Machine Building were in Russia. They hastily, under the pretext of saving the branch, put high technologies up for auction in the legislative halls of the American administration. They put the world's most powerful boosters, the RD-170 engines, outstanding in their performance, and the Soyuz-TM ship up for sale. There was even talk of selling the Mir station itself.

The Americans did not have to think it over for a long time and lifted the embargo on the importation of our latest rocket-space technologies. It is possible to understand the American pragmatists. The same can be said for the quick-acting business executives of our fraternal republics. Prior to the setting up of a solid

Russian governmental structure they hastened to acquire technological resources for themselves for the future.

But Russia obviously is losing out. And it seemingly has never occurred to us that by putting unique equipment and technological know-how on the block we are dooming the country to loss of prestige as a civilized space power and the status of a serious trade partner. The fact is that crises, however severe and prolonged they may be, have the habit of winding up in a technical-economic upswing in the most unexpected fields. For Russia cosmonautics may become this field.

But for the time being no thought has been given to such a scenario in Russia. A communication in the NEW YORK TIMES to the effect that the Americans are adhering to a policy "whose objective is to achieve such a decline of the space and military industry in Russia that it cannot constitute a threat to the United States even in the immediate future" has not alerted us. As indicated by the press there, in American governmental circles there is "an extremely influential industrial lobby which is capable of postponing or blocking any changes in American approaches to Russia, which are regarded as a threat for American industry..." Indeed, it is the opinion of Harvard University specialists that if Russia receives permission for the launching of American satellites with our boosters it not only will receive 6 billion dollars annually in profit, but also would inflict irreplaceable losses on the American aerospace industry. Without question they will not allow this. But there is no reason to give up hope. After all, space activity is a many-sided concept and "profit" here at times is not determined in money terms but by the nature of political decisions and the degree of impact of cosmonautics on the administrative and productive structures of a country. But, alas, for the time being not in our country.

Not our, but French and American cosmonautics informed the world about the Chernobyl tragedy. Their data served as a basis for decisions concerning the organization of coalition forces for operations in Kuwait. It was not the Soviet "asymmetric variant," but their SDI which in large part determined and which will long determine the direction and depth of the Russian-American dialogue and disarmament initiatives.

Their possible scenarios were already laid by the Americans in their new military-political doctrine, whose draft was prepared by the Heritage Foundation in 1992. It provides both for a unilateral withdrawal of the United States from the strategic arms pact of 1972, but also the deployment of a global antimissile system based on SDI development work beginning in 1996. Plans call for 1750 antimissile complexes, a thousand of which will be put into space and later will be replaced by directed energy weapons. For the time being this is a project, but the total foreign policy return of American military cosmonautics is obviously significant here. In his time President Lyndon Johnson asserted that its real worth would

exceed the real cost of all nuclear weapons systems then in existence. Reference was to space reconnaissance, which made it possible to adopt valid decisions concerning matters related to construction and technical outfitting of the army, thereby maintaining assurance of their own military superiority and saving billions of budgeted dollars. Those times have passed. The present-day Lacrosse radar reconnaissance satellite, for example, costs 500 million dollars. A B-2 strategic bomber is 17 million more expensive. An IMEWS early warning satellite costs 1.5 times more than a B-52 bomber. But these figures are insignificant in comparison with the cost of the political decisions adopted on the "recommendation" of space vehicles. In response to their "prompting" American Pershings and winged missiles were deployed in Europe to counterbalance the Soviet SS-20 missiles which were stationed there. The price for this "counterbalancing" was nine years of alarm for the entire continent. It was precisely materials from American space reconnaissance which made it possible to convince the king of Saudi Arabia of the aggressive intentions of Iraq and led him to the decision to allow American forces onto the territory of his country. So that the Johnson criterion for evaluating the real significance of military cosmonautics not only remains valid but also acquires an obvious foreign policy coloring.

With respect to the economic aspects of cosmonautics, its unprofitability, of which we wish to convince ourselves so zealously, a great many questions can arise here. Something which causes perplexity is the prices which we set for our transactions in this field and the list of organizations proposing such services in the name of Russia. Why is it that the 127 members of the INTELSAT consortium say that the cost of annual leasing of one satellite communication channel varies from 1.8 to 5 million dollars, whereas our Glavkosmos offers the entire Gorizont satellite for only 1.5 million dollars annually? Why did Glavkosmos ask 28-35 million dollars for the Proton, whereas the American Department of Transportation asks five times more for a similar class of carrier? The IRS-1A natural resources reconnaissance satellite launched by India with our assistance in 1988 began to supply space photographs to Bangladesh, Nepal, Pakistan, China and Sri Lanka. At the same time that we are satisfied with sporadic sales of our materials abroad through intermediaries. First through the Estonian Space Agency and then through the British, Swedish and American British Aerospace, Marconi Space Systems, Space Corporation, Sigma Projects and Cantree Trade Service Corporation. And the French Spot Image Corporation was given the exclusive right to the commercial dissemination of photographs from the Russian Almaz radar satellite. The volume of Spot Image business in the countries of Southeast Asia alone is billions of dollars annually. And what did we get?

The grandiose character of our future prospects at times also has an unconvincing ring. A flight to the Moon or to Mars is an attractive undertaking. The

Americans also intend to go there. But they want to test 16 types of robot apparatus with elements of an artificial intellect before a man is landed. On the moon they intend to establish a manned station, organizing the production of "helium-3," a fuel for the developed thermonuclear reactors. According to calculations, the cost of a gram of lunar "helium-3" will not exceed a thousand dollars. One Space Shuttle flight will deliver 25 tons of raw material for this fuel, which would be adequate for covering the annual needs of the United States for electric power at the 1987 level. The cost of the project will be 30 billion dollars, with a net profit of 25 billion. And what do we intend to do? We cling to the project for an 18-ton "tsar-satellite" with its mythical 1.5 million communication channels at a cost of 30 billion. This now, when the treasury is empty and the world is absorbed with miniaturization. After all, we could convince the international communications center that the development of a satellite communication station in an "attache case" in 1 1/2 years and its transport to Australia would give us no difficulties and in fact we organized on-line communication with Moscow via the Gonets military satellite, causing envy among our potential partners and competitors!

What are we to do? First of all: answer the questions: for what reasons (prestige, scientific research, profit, development of economy...), for what purposes (scientific, military, commercial...) is cosmonautics necessary? Second, the space research program must be codified, defining the priorities and the form of interaction with the neighbors of the former Soviet Union. After all, in a divided country there can be no unified cosmonautics and therefore the space interrelationships of the young countries must be civilized and on a sound basis. It is not without reason that the Rand Corporation think tank recommends that an international space alliance of the NATO type be established under the aegis of the United States. France is speaking out for such a union, and it is understood in Europe. We, however, are gripped by pride in national isolation. Third, the list of administrative structures must be reexamined. We have contrived to break cosmonautics down even within the framework of a single ministry: among the antiaircraft defense, air force and military-space forces. Fourth, relying on world experience, a register of the possibilities of cosmonautics must be defined: technical, commercial, operational-informational. The prices for all kinds of commercial services and copies of equipment must be determined. Doing this, we will understand why the United States is acquiring from us the Topaz nuclear engine for ten million dollars, but for developing their own "SP-100" are allocating four times more for one year alone.

And, finally, we must organize forms of cooperation with the space agencies of close and distant foreign lands, precluding the outflow of the latest technology without an equivalent exchange. Then it will be possible to think of overcoming COCOM barriers. The first step could be a conference of countries which are

the holders and users of space production at which it would be appropriate to speak of international laws. But for this it is necessary to accelerate the adoption of our laws in this field.

Russian-French Space Cooperation Continuing

937Q0144A Moscow *SEGODNYA* in Russian
No 26, 18 Jun 93 p 7

[Article by Mikhail Chernyshov, under the rubric "Space": The Russian Space Program Continues to Be in Demand in France"]

[Text] Our longtime partners in space research—the French—are setting a unique record by sending a cosmonaut up to the orbital Mir station for the fourth time. If everything goes according to plan, Jean Pierre Haignere, a French researcher, will go into orbit with Aleksandr Serebrov and Vasiliy Tsibilev in early July. For about three weeks, he will work as part of a crew of five. Then he will return to Earth with Mir's current inhabitants, Gennadiy Manakov and Aleksandr Poleshchuk.

The flight is being performed at a time that is most difficult for the Russian space program, but one would like to think that the experience garnered from joint work will enable us this time, too, to surmount all the problems that are arising—from the leasing of airplanes to transport the space crews to the cosmodrome to the drinking water at Baykonur, whose quality of late can't stand up to any kind of criticism.

The history of Russian-French cooperation actually has its origins in the launch of the first satellite. In 1966, General de Gaulle paid a visit to Baykonur, thereby attaching state-level status, if you will, to our space relations. Several large joint projects were performed in deep and near space: Ionosfera [Ionosphere], Luna [Moon], Venera [Venus], Kometa Galleya [Halley's Comet]. Now the Mars-94 mission is being prepared: Russian and French specialists, together with an impressive team of other foreign participants in the project, will begin a new cycle of research involving the "red planet."

Manned flights make up a special chapter. A participant of the first two missions, Jean-Lou Chretien, set up the beginnings of the extensive program Antares, which to this day is being performed aboard Mir. The program calls for biological, medical, and physical experiments associated with studies of spaceflight factors, weightlessness, radiation, and lengthy stay in close quarters. For the French specialists, that research represents a preparation for future work to be done in their own programs: on the reusable Hermes spacecraft and the orbital station Columbus. In that same vein are technical experiments, such as EVAs. Chretien was the first Western European cosmonaut to perform such an operation.

Michel Tognini took the research baton in the summer of last year. Now it's the turn of Jean Pierre Haignere, his backup. In all, the program is designed for three more flights, which are to take place before the year 2000. However, all the discussions of the programs—both Russian and Western European—are, unfortunately, sketchy.

As for the Russian program, it has recently been revised a number of times because of financial difficulties. Buran flights to Mir were set and then postponed again. Now, it seems, nobody at all really knows whether those flights will take place, even though many preparatory operations have already been performed. All the efforts of the specialists are being directed now toward keeping Mir in working condition until 1996. The station has been in operation since February 1986. It still hasn't achieved its full configuration. It looks as if the two absent modules will never dock with the worn-out core unit. It may not be until after 1996 that our Mir-2 will come on the scene.

As for the Western European program, it also has plenty of difficulties. For many years, the Western Europeans linked the future of Columbus to the American Freedom station. It was to be one of the main modules. Many industry people and figures from the European Space Agency (ESA) didn't like such a close linkup, because it placed the Western Europeans in a situation of technological dependence on the United States. By the way, those fears were borne out. Appropriations for Freedom have now been cut dramatically, and for Columbus that means that some sort of backup versions of putting it into orbit have to be sought out.

In addition to the orbital module, the Western European space program has two other key elements—the Ariane rocket and the Hermes space shuttle. Those are expensive items. Voices have long rang out that ESA should set up closer ties with the Russian space program. That would make it possible to lessen the burden of spending. Especially since some of the countries—Germany in particular—have reduced their share of financial participation in the ESA program in recent years.

In light of that, it's understandable that the Western Europeans and the recently created Russian Space Agency are seeking out mutually beneficial versions of cooperation. Several important decisions have been made on that score. They involve the participation of Russian specialists in the studies pertaining to Columbus and Hermes. But in specific terms, things have moved ahead only in the realm of joint manned flights. At Zvezdnyy Gorodok [Star City], besides French cosmonauts, cosmonauts from other ESA member-countries are undergoing training now—cosmonauts from Belgium, Spain, and Sweden.

The forthcoming Russian-French flight differs from all the previous flights in that it will be performed on a completely commercial basis, that is, the French side

will not, as before, reimburse only part of the expenditures associated with delivery of the instruments and with the trips our specialists had to make to France, but will invest the entire sum in hard currency: \$12-15 million. That is considerably less than the Americans get for flights. But apparently that is, for now, the only way for the Russian space program to earn even a little money. According to the estimates of RSA specialists, all the commercial activity of the Russian space program—both ruble and hard-currency revenues—is capable of bringing in only a fifth of what is needed for a more or less tolerable existence. The other four-fifths needs to come from the state budget. Some R48-50 billion (in 1993 prices) are needed annually. And no one knows yet whether that money will be found or not. And all our future space prospects depend on that very thing.

Troop Riot at Baykonur Causes R100 Million in Damage

937Q0144B Moscow PRAVDA in Russian 9 Jun 93 p 8

[Article by G. Loriya, from Kazakhstan, under the rubric "Our Whole Life Is An Unusual Event": "Cosmodrome Losses at 100 Million Rubles"; first paragraph is source introduction]

[Text] Three barracks set afire, two headquarters and a club burned down, two warehouses plundered, two stores cleaned out—that's one of the results of the rebellion that took place in the construction units at Baykonur. Preliminary estimates put the losses at 100 million rubles [R].

Unlike in the rebellion of last year, the troops didn't present demands of any kind. The rebels simply pulled out of those same stores everything that was within reach of their angry hands: alcohol, chocolate, shoes, new uniforms.

According to existing reports, one soldier received a bullet wound, and several others received bodily injuries.

Last year, the construction units at the cosmodrome were transferred to the jurisdiction of Kazakhstan. Now draftees are gathered here from that republic. But many officers and warrant officers here are Russian. Having involuntarily become "Kazakhs," they get pay that is much smaller than what is paid in the Russian army. For example, the salary of a colonel, chief of the construction headquarters, is smaller than that received by Russian warrant officers at Baykonur. And it is only a little bigger than the pay received by troops serving there on contract.

A special commission arrived from Alma-Ata to "analyze the flights." It included representatives of the Supreme Soviet, Ministry of Defense, and Ministry of Internal Affairs of Kazakhstan. When the officers and the warrant officers of the construction units met with the commission members, they made a demand:

within a month, bring their pay up to that of Russian officers and warrant officers, or transfer the subunits to the jurisdiction of Russia. Otherwise, they intended to leave the service.

There's likely to be a visit to the cosmodrome in the near future by parliamentary delegations from Kazakhstan and Russia. They will be preparing documents for the expected meeting of N. Nazarbayev and B. Yeltsin.

In all, about 500 people of different nationalities took part in the disorder. A group of alleged instigators has been detained, and several dozen troops have fled.

Future of Plesetsk Space Launch Facility Pondered

*93WC0091A Moscow ROSSIYA in Russian
No 29, 14-20 Jul 93 (Signed to press 13 Jul 93) p 9*

[Article by Galina Mashtakova under "Shield and Sword of the State" rubric: "Space Knights of Russia"]

[Text] The lads of the military space forces of the USSR solemnly guarded the main military secret of the country—their involvement in the romanticism of space investigations. And to get through the difficult days and nights, they hid from the eyes and ears of their compatriots in the impenetrable taiga of Arkhangelsk. The official date of the birth of the "Plesetsk" space-launch facility is considered to be 15 June 1957. Only then it was called something else—a range for testing military missile hardware....

And while the world was enjoying the smile of Gagarin, the "secret physicists" from the military space department covered themselves in the direct sense of the word with the nuclear-missile shield of the country of the Soviets and wrote their scenarios for space wars with the damned bourgeois....

With perestroika, the military space forces became an independent branch of the Russian Armed Forces, having separated themselves from the missile forces. And they really obtained a special status with the collapse of the Soviet Union. For only they are now prepared to answer the question of whether or not Russia is to be a space power. Today the fate of Baykonur depends on the competent, intelligent, and calm politician Nursultan Nazarbayev. But what will tomorrow bring? According to the apt comment of one of the officers of the military space forces, the time may be coming when only camels will graze at our "Canaveral." And this means that the space-launch facility at the Plesetsk test range near Arkhangelsk is the only hope and support for Russian astronauts.

Where does the Ho Chi Minh Trail lead?

To some degree or other, everyone knew about the secret of its existence. And before anyone else, of course, the potential enemies knew. At the beginning of the 1960's, they took the bearings of the second or

third launch of a space vehicle. From that very moment, the secret test range in the north was under their close observation, even to the point that articles about it were published in the popular journal YUNY GEOGRAF [Young Geographer]. Shortly after that, local Arkhangelsk pathfinders made a path in the taiga that they cleverly named Ho Chi Minh. And by no means did they do that to spy or admire the "taming of fire" but with the sole more than earthly goal of supplying themselves with inexpensive delicacies and "privileged" industrial goods. That was during the time of stagnation, when different kinds of sausage quietly lay only in towns like Zvezdnyy. And bananas cost 1 ruble 80 kopecks at Mirnyy (a closed military town at the Plesetsk test range).

Officers now remember those heavenly times with sadness in their voices, although even now they live rather well. In any event, you cannot compare the people here at Plesetsk with those unfortunate people who are being moved from far-away places abroad to an empty place or with those whom perestroika caught by surprise in nearby foreign territory. And neither they nor their relatives want to "open" their closed city: in a local referendum, 90 percent of the population spoke out against "breaking windows" in the civilian civilization. The city lives under its own military laws and precisely this helps people to work and honestly to perform their duty to their homeland despite the general disorder.

But however they call what was spread out near Plesetsk—the "younger brother of Baykonur," "Plesetsky Space-Launch Facility," and "International Space Center Plesetsk"—it was conceived and begun as a range for the testing of combat missiles. And the first bosses here were missile people. These missiles that once stood on alert status now launch space vehicles. And in those days, when they were aimed at the United States, Nikita Sergeyevich Khrushchev pounded his shoe on the speaker's stand of the United Nations and threatened to use them.

Conversion of the "Topol"

From a discussion with Gen A. Perminov, chief of the test range:

[Question] Anatoliy Petrovich, we keep on disarming and setting up American monitoring equipment everywhere that it is possible to do so. In one sense, this is remarkable—we are ceasing to frighten the world. But is it not so that there must be reasonable limits to everything on earth? Missile forces are strategic forces. And if we think "strategically," then are we not depriving our children and grandchildren of a "shield"?

[Perminov] Well, in the first place, we are setting up the equipment not only here but there as well—in accordance with the agreement, as they say. And as for missile technology, no one has taken this task away from us.... Programs are being worked out and science

is thinking. And it is our "own," by the way. To be sure, no matter how many scientists are trained in our postgraduate study, Moscow takes them away from us. And that is understandable, for they are first-class specialists! Here science is applied in nature: technology and testing. There are, of course, complications with financing—there are no longer the sort of "injections" that we had before. But, as long as there are prospects of development, this means that there is stability and people can work quietly. A year or two ago, many were deserting the army, for the "market" was promising a more abundant life as civilians. We were affected by this too. We caught the fever. The result was that the most dependable people remained. And this is important: we are forces with greater responsibility.

We would like to be hopeful at least with respect to the notorious nuclear warheads....

This year the missile people have carried out the latest conversion program: on 25 March, the intercontinental ballistic missile "Topol" launched a space vehicle for the first time. Previously after testing such missile complexes were simply blown to pieces, which did not by any means increase their efficiency. Now space vehicles will be launched on the basis of a modified "Topol." The next launch will be in the fall. Naturally it will be for national economic purposes....

In general, the rumors about the "dreadful" military function of the test range are greatly exaggerated. Yes, here there actually was a training center for the retraining of military specialists of the missile forces: officers and soldiers master new equipment and here they acquire it and set off for their place of service. This is how it is: equipment is improved and so are people. But practically every month the chief of the test range has to appear at various meetings of vigilant "servants of the people" and explain that the missiles are being tested without a "filling" and that there are no nuclear weapons at Plesetsk and never were. If the "filling" was tested, then it was at Novaya Zemlya and Semipalatinsk. Here they teach people to maintain and service that which is on alert duty in different corners of our immense Russia. Without a doubt, the inhabitants of Arkhangelsk Oblast have reason to be concerned about ecological safety. But they are clearly not looking for the source of the danger there. God knows that the local Plesetsk officers are not about to feed their own children nuts and mushrooms gathered in their spare time beyond the barbed wire. They if anyone know how edible the gifts of nature are. And the presence of grayling in the stream near the launch facility indicates something....

And with the passage of the years, the space-launch facility itself becomes quite "peaceful" [mirnyy] in accordance with the name of the town.

The Magic of Figures

From a conversation with A. Ovchinnikov, chief of the center for the testing of space vehicles:

[Question] Somehow in our consciousness the mastering of space has become firmly associated with the names "Baykonur" and "Kapustin Yar." But scarcely anyone knows about the hard work that is done at Plesetsk. We carry out two-thirds of the country's space program. In America, they prepare half a year for one launch, whereas we have 50 to 60 launches a year. There were 82 launches in 1978! And practice has now shown a reliability of 0.98.

For this reason, the Americans themselves prefer to launch their space vehicles from Plesetsk—cheaply and reliably.

"0.98" means an almost 100-percent probability of success. Almost.... They showed us the monument with the eternal flame and reservedly and briefly commented: "Those are our boys." Here the questions stop at once. It is painful to remember how within just a few minutes the launch pad became a huge melted field in the midst of the taiga. After the last accident, the fourth launch complex (there are a total of nine here) was in a process of restoration for three years. And it was precisely from it, from the fourth, that in our presence the space vehicle "Resurs" (to investigate the natural resources of the earth) was put into orbit with the "Soyuz" launch vehicle. For three days, a combat crew of a unit of the military space forces prepared it for launch—from that very minute that the space vehicle joined to the launch vehicle on the erector began to move smoothly on rails from the assembly and testing building to the "iron hectare" (as the officers call the launcher). And by tradition, the unit commander walked all the way down the cross ties in front of the rocket—just to make sure. Korolev was the first to go this way before launch in the early 1960's.

There are 260 little stars at the launch facility. That is how many launches there have been. The facility is honored. In such cases, they say that it is time to retire. But...there is no replacement, just as there is no Ukrainian Soviet Socialist Republic, the homeland of the facility. Orders are now being distributed to military plants of Russia on an urgent basis. St. Petersburg promises to deliver a new launch facility by 1998. If only that were all! For three months now, Shostka has not been sending film. They are raising their prices and demanding hard currency. Because of this, they cannot launch the space vehicle "Kobalt." The officers are perplexed: "We went there and there is nothing much going on. Even the flies are buzzing around the shops. Can it really be that 'Svema' or 'Tasma' cannot make this film?" And they add: "Russia must have everything that it needs so that it does not have to get down on its knees."

Getting Off Their Knees

That is all so. It is not right for Russia to be on its knees and especially because of cable fuses and electrical equipment for ground verification of launches from Kharkov or refueling hoses from Belarus. The establishment of our own "space" infrastructure on Russian soil is an indispensable condition for us who lay claim to being a space power.

By the way, the missile people here have certainly shown themselves to be "forces with greater responsibility." Their "losses" from the disintegration of the Soviet Union are much less than those of others. It is apparent that they benefited from their specificity and secrecy. Most of the equipment was produced at Russian plants but within a year it was possible to distribute the orders that were oriented toward nearby foreign countries to the "middle strip of Russia," figuratively speaking.

Once again you involuntarily think about the responsibility of politicians for our security. It may be that it is again necessary to show restraint and not to "slam the door," calculating a few moves in advance what is advantageous for the Fatherland.

With the background of general and local disarmament, it appears that the Plesetsk test range is not losing its importance but rather is becoming more important. It is not for nothing that the president of the country, the commander in chief of the Joint Armed Forces of the CIS, and the Minister of Defense of Russia visited here in the last year. And one of the latest launches was observed by M. Kolesnikov, chief of General Staff of the Ministry of Defense of Russia, and V. Ivanov, commander of the space forces, along with us.

To remain one of the major and leading powers, Russia needs a dependable nuclear-missile shield and prospects for the development of space research.

And in this connection, it is by no means unimportant whose hands are operating "ground" and "underground" control consoles. When he left us, Gen A. Perminov said: "I am quite confident that there will be no tragedies and no accidents in the missile forces...." One would like to believe that. And let the "probability of 0.98," as the missile people and cosmonauts say, always be confirmed with a reality of 1.0.

Space Competition Agreement Discussed

*93WP0216A Moscow KRASNAYA ZVEZDA in Russian
31 Jul 93 p 4*

[Article by engineer A. Andronov: "It Is Easier To Penetrate Outer Space Than the Market"]

[Text] The launch of commercial space satellites is acquiring continuously increasing popularity in the world. This is both a lucrative investment of money and enormous profits. What is Russia's place in the international outer space market?

The lion's share of orders for the production of satellites here belongs to the United States, but the countries of Western Europe, headed by France (space-launch vehicles of the Ariane family), dominate in the sphere of space launch services. As for Russia, after numerous working meetings, a certain preliminary agreement has been drawn up that is now being discussed widely in the Western press. Its main point is:

Russia is permitted to conduct not more than eight launches of the Proton space-launch vehicle to put foreign payloads into geostationary orbit. This is the plan to the year 2000—that is, calculating one launch per year.

The difference between the cost of a Russian and a Western rocket must not be more than 7.5 percent of the price level established by Western competitors. Yes, the West is afraid of our low prices in conjunction with the RK's [space-launch vehicle] high performance characteristics. But a question arises on how to orient oneself here, if at the moment that negotiations are being conducted, the price of the competitors most often remains a secret.

One other condition is the continuation of negotiations on the nonproliferation of rocket technology. In practice, this means, for example, breaking a contract, which is beneficial to us, for the delivery of cryogenic rocket engines to India.

It is interesting to note that China, which has been launching commercial satellites since 1990, is not experiencing such strict restrictions on the part of the United States, probably because it possesses far more modest capabilities in this sphere that do not arouse particular concern in the West. The Russian-American agreement was met with great satisfaction by representatives of a large part of the rocket construction firms of the United States and Europe, inasmuch as it will reduce to a minimum Russia's influence on the space technology market right up until the beginning of the next millennium.

We cannot under these conditions demonstrate the obvious advantages of our rockets: low cost and high reliability and the practicality of preparation. As has been said, the Americans have stipulated the price level and the intensity of launches, and Western experts expect that, with the passage of time and to the extent that there is a drop in labor productivity, discipline, and quality of work, the high reliability of Russian rockets will be lost. Well, this also cannot be ruled out. Already in May of this year, the launch of Proton, our main commercial rocket—one of the most reliable in the world—was unsuccessful. At the same time, the Americans hope to create their own heavy space-launch vehicle by the beginning of the 2000's, inasmuch as for the time being they have nothing in this class to oppose our Proton.

However, it is naive to expect a favor from the Americans. But Russia still has enough capabilities to

occupy a place in the international market that is consistent with its status. The most rational way is to learn how to build, within the framework of conversion, competitive communications space apparatuses that Russia could launch in the interests of other countries without American licenses. Negotiations are being conducted right now with foreign firms about the lease of Russian communications satellites of the *Gorizont* type that have been placed in geostationary orbit over the Asia-Pacific Ocean region. It is important for us to take the first steps.

Missile Guidance System Firm Seeks Commercial Role

93UM0745A Moscow NOVOYE VREMYA in Russian
No 30, Jul 93 (Signed to press 20 Jul 93) pp 16-17

[Article by Margarita Shii under "Conversion" rubric: "Secrets of Island N: What Are They Doing on the Island of Gorodomlya? Some Say They Are Producing Bacteriological Weapons, Others—Strategic Missiles"]

[Text] The "foot-and-mouth-disease" institute, the design bureau of the renowned German designer Werner von Braun, a branch of the firm of Sergey Korolev, and the closed defense enterprise "Zvezda" (Osstashkov-3) are all landmarks in the history of the island of Gorodomlya.

Soviet Missiles of German Origin

One reaches Gorodomlya by motor boat in the summer and fall, over the ice of the Seliger in winter, and with the help of an icebreaker during the spring when the roads are bad. Although nature here beckons tourists and fishermen, the way to the island with its pine forest, berries and mushrooms, and fish that can practically be caught by hand is blocked directly at the pier by a control passage with a menacing guard. The way here has been open only with special permits since the 1930's.

The so-called "foot-and-mouth-disease" institute (remember, in the "Caucasian Captive," the injections of the famous trio Nikulin—Vitsin—Morgunov against foot and mouth disease, the disease of cattle?) actually did work here but what it dealt with was the search for a vaccine against foot and mouth disease or something else that is still unknown.

Those who love sensations talk about a secret bacteriological weapon developed here. The local people, among whom no witnesses of these events remain—as if the earth had swallowed them up!—nevertheless refute these rumors. They said that some biologists and chemists worked here but then were cut back and finally left.

The ship pines that Ivan Ivanovich Shishkin depicted in his famous painting "Morning in the Pine Forest" could say a lot about the birth of the Soviet missile programs and about how in 1946 they brought German specialists here from the city of Penemuende on the

Baltic Sea. The Germans worked at Gorodomlya right up until 1952 and then they were sent home. Even now in Hamburg there are 12 families comprising an association of fellow countrymen who sentimentally—no joking—remember the Russian period of their work.

The Germans did not live as captives: they had their servants and their diversions. After the departure of those who helped us to strengthen our defensive might, they drastically changed the subject matter of the closed developments on the island.

Gorodomlya has been working "for space" since 1957. At first they organized branch No 1 of the Sergey Korolev Design Bureau here and a little later the enterprise "Zvezda," which exists on the island to this day. The 100-percent defense order in the recent past guaranteed a comfortable existence for this highly technological production. The best people from the entire Union gathered here—graduates of the leading technical VUZ's with gyroscopic departments.

The main output of the enterprise is gyroscopes for inertia navigation guidance systems or, more simply, for orienting space ships in the vastness of the universe. The accuracy of these supersensitive instruments 2X2 cm in size makes possible the automatic docking of stations. They are in operation at the orbital and missile complexes "Mir," "Proton," "Buran," and "Energiya." Formerly the production of one gyroscope cost about 10,000 rubles [R] but today it is about R3 million.

Formerly the share of purely military production (if our space can be considered peaceful) was about 40 percent. Today the defense order has declined to 15 percent and is the least advantageous for the enterprise.

China Saves

Today the island of Gorodomlya is the enterprise "Zvezda" with its infrastructure and a rest home for the colleagues from Podlipki near Moscow. To avoid vibration, flights of aircraft over the island are prohibited. The railroad is located 15 km from the shops of "Zvezda." The island has everything for living and recreation, even an internal lake besides the external Seliger.

More than 4,000 people live here, all of them coworkers of "Zvezda" (except for the children), for whom there is a swimming pool, a house of culture, and excellent medicine. Formerly the enterprise was so stable that it spared no expense for the welfare of its own island and even of the rayon center. The road from Torzhkov to Osstashkov was also built at their expense.

"Zvezda" has its own fleet with more ships than the city's own steamship company. This is practically the last stable enterprise in the Russian missile-space branch.

They began to talk about conversion here long before it became so prevalent. The conversion program on Gorodomlya began in the mid-1980's. At that time, the leadership of "Zvezda" made a fundamental decision: it is inexpedient for the highly qualified personnel to be pushing consumer goods such as irons or shovels or even complex but amusing toys like a little electronic-mechanical dog that barks, stands on its hind legs, and wags its tail. The little dog, by the way, is made up of 107 parts.

A lot of ideas are coming out of "Zvezda" that may be applied in the most varied branches of the national economy. An example is an electrostatic paint sprayer operating without bearings that makes it possible to prime the surface of a car without additional hand processing. The AZLK (Motor Vehicle Plant imeni Leninskiy Komsomol in Moscow) has purchased such a line and has been operating it without repairs for six months now. There have been no breakdowns.

There are also more exciting developments. There is an air-cooling system that makes it possible to produce refrigerators without freon. The cooling is down to 67 degrees Celsius. Kazakhstan wanted to order a batch of such units to freeze slaughtered cattle directly in the pastures but the disintegration of the Union prevented this. The story was the same with a Minsk plant for refrigeration equipment.

For the time being, the only reliable customer of "Zvezda" is China. In Beijing, an SP [expansion not given] will soon go into operation for the production of inertial navigation systems for the civil fleet. The new word in aviation technology is the navigation-piloting system GLONAS with satellite correction. This development has not yet interested our industrialists but the Chinese have decided to invest millions of dollars in it. The expenditures must pay for themselves within 5 to 6 years. "Zvezda" is investing its intellectual property in the SP.

The latest developments by "Zvezda" specialists are instruments to locate oil bore holes. Inclinometers of this kind do not exist anywhere else in the world but it turned out to be a rather complicated task to take them to the world market and thereby squeeze the Americans. Essentially these instruments could revive 80 percent of the bore holes: it is well known that a developed oil bore hole leaves behind up to 60 percent of the oil. So far there are no customers for this output, just as there are none for prostheses working on the basis of signals from the brain. Essentially this is an almost adequate replacement for human organs.

Falling "Star" [Zvezda]

The defense industry is supervised by five different departments, although there is still no special structure that would coordinate a government conversion program. Conferences are convened at the office of Oleg Soskovets or Vladimir Shumeyko or Andrey Kokoshin.

Viktor Glukhikh, chairman of the Committee of the Russian Federation on the Defense Branches of Industry, still does not have any official powers from the state to influence policy in the missile-space sphere.

"Zvezda" Director Boris Mokrushev refers to the Chinese experience in conversion, where they immediately determined a list of priorities and set up a state agency that deals with conversion. The second step was to make a list of those enterprises that needed to be assisted first of all. "Credit for all is no solution, that only prolongs the agony," thinks Mokrushev. Moreover the loans from the Central Bank go to the current accounts of the enterprises for two or three months and during this time the money is definitively devalued.

Boris Mokrushev thinks that it is necessary to retain a maximum of 300 enterprises in the entire defense complex (approximately one-third) and not to allow them at least to perish. "If the government does not define the rules of the game in the near future, we will also play our own game."

For the time being, "Zvezda" is fairly calm, although the wages are of course ludicrous for specialists with such qualifications—about R30,000 a month.

Does Russia Want to Sit on the Security Council?

It is useless to expect immediate returns from conversion. It has been calculated that a conversion ruble will pay for itself in two to three years and R2-3 must be invested in it. The volumes of production have been reduced substantially. But the most frightful thing is that working capital has been frozen and credit lines have not yet been opened, although there are decrees on this from the Supreme Soviet of the Russian Federation and government.

Essentially production is not being renewed and the head research institutes are closing or turning their space over to commercial structures. The plants are shying away from defense orders like the devil from holy water. Government indebtedness to the defense people is growing.

The deficit of working capital at "Zvezda" amounts to R500 million. The electric boiler house built "for good" also turned out to be a calamity—it consumes too much electric power, which must now be purchased without rebates. "Zvezda" is asking the Defense Ministry for at least R200 million to cover top-priority debts to pay for electric power and to pay off accounts with suppliers.

"Russia must finally decide: Does it want to be a world power and sit on the Security Council or not?" says the director of "Zvezda." If it does not want to fall to the level of third-rate countries, then it is necessary to determine a long-term (for 10 to 15 years in advance) conversion program. Otherwise in the near future the entire former defense complex will die away and its highly qualified personnel will go to other cities and towns in search of a

better share. And where can they go: on Gorodomlya, for example, there simply are no other enterprises...."

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